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ERRATA

Page 18 line 6 before " **Vorläufige** " insert RIEMSCHNEIDER (R.) & KÜHNL (A.).
line 29 for " C. Bastiansen " read " O. Bastiansen "

,, 65 line 31 for " antogenous " read " autogenous "

,, 106 19 lines from end for " Downes " read " Downs "

,, 162 line 21 for " *A. annulatus* " read " *A. annulipes* "

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

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HADDOW (A. J.), VAN SOMEREN (E. C. C.), LUMSDEN (W. H. R.), HARPER (J. O.) & GILLETT (J. D.). **The Mosquitoes of Bwamba County, Uganda. VIII. Records of Occurrence, Behaviour and Habitat.**—*Bull. ent. Res.* **42** pt. 2 pp. 207–238, 27 refs. London, 1951.

In this paper, which is one of a series [*cf.* *R.A.E.*, B **37** 208], a list with brief notes on prevalence, behaviour and habitats is given of 160 species, subspecies and varieties of mosquitos that were found during field work over a period of ten years in Bwamba County, Uganda. In almost every case where a long series of specimens was available, the range of variation within a species was considerable. Notes on variation are therefore included in the case of each mosquito that showed interesting features in this respect. In addition to the mosquitos listed, all but one of which are named, at least ten forms were seen that were almost certainly undescribed, but of which the material available was not adequate to allow of the designation of a new species or subspecies. Attention is drawn to the existence of these under each genus.

KETTLE (D. S.). **The spatial Distribution of *Culicoides impunctatus* Goet. under Woodland and Moorland Conditions and its Flight Range through Woodland.**—*Bull. ent. Res.* **42** pt. 2 pp. 239–291, 2 pls., 13 figs., 9 refs. London, 1951.

The following is based on the author's summary. Weekly observations on two populations of *Culicoides impunctatus* Goetgh. were made in 1948 at Bannachra and Wester Bannachra, near Loch Lomond, Scotland, throughout the whole *C. impunctatus* season by means of adhesive traps. Each site had an area of five acres of which half was composed of woodland and half of moorland, and 22 catching stations, each consisting of three traps placed 2 ft., 6 ft. and 10 ft. above the ground, were erected on each, equal numbers being in the woodland and the moorland. Of a total of 67,033 *Culicoides* trapped, 65,576 (97·9 per cent.) were *C. impunctatus*. In 1949, observations were repeated in Bannachra woodland only.

There were two population peaks, one in the first week of June and one in late July, and it has been concluded that there are probably two biological races [*R.A.E.*, B **39** 195]. The results are analysed as a whole and also for the two seasonal waves separately, the week of minimum abundance between them being omitted in the latter case. When seasonal effect was eliminated,

the stations showed very real differences between their weekly catches. Catches were always large at some stations and small at others. The total seasonal catch at each station was plotted on plans of the two sites, and it then became apparent that there were two centres of high density at Bannachra, one in the woodland and the other on the moorland, while at Wester Bannachra there were two foci in the woodland and a very diffuse zone of high density on the moorland. The centre of high density in Bannachra woodland was associated with a concentrated breeding place, which supplied all the adults of the woodland (2½ acres). This centre remained unaltered in 1949. The importance of these observations on the control of *C. impunctatus* is discussed.

After the breeding place in Bannachra wood was discovered, it became clear that most adults of *C. impunctatus* moved eastwards from it. This was attributed to the influence of the prevailing south-west wind. There was a linear relation between the logarithm of the catch and the distance from the breeding site, and the reciprocal of the regression, which is the distance at which the density has decreased to one-tenth of its initial value, is designated the density coefficient. The density coefficients were 62·5 yards for males and 64·9 yards for females. An attempt is made to separate the effects of "dilution" and "mortality" on the density of *C. impunctatus*. The mortality of males and females is shown to be normally distributed with respect to the logarithm of the distance flown. These distributions are male $1{\cdot}867 \pm 0{\cdot}197$ (=73·6 yards; 46·8–115·9 yards) and female $1{\cdot}885 \pm 0{\cdot}197$ (=76·7 yards; 48·8–120·8 yards), the mean representing the distance at which half the population has died or gone to earth. From the density/distance formula, the average distances flown by males and females are calculated; they are 79·0 and 81·4 yards, respectively.

Analysis of the vertical distribution of *C. impunctatus* revealed that each station had its own definite pattern. Stations situated amidst birch saplings showed differences between themselves, which were not related to the ground flora. It is suggested that these are related to the height of the leaf canopy. The catches in an oak wood, however, where the base of the leaf canopy was about 20 feet from the ground, indicated that the midges had a self-imposed "ceiling" of little more than 10 feet. The ground flora had an appreciable effect on their vertical distribution on the moorland. Thus, equal numbers were caught at each height where the ground flora provided only about 6 ins. of shelter, but more were caught on the two-foot trap in stations situated amongst *Juncus* sp. or in small sheltered clearings in the herb layer. However, the shelter provided by bracken (*Pteridium aquilinum*) appeared to be less attractive. In the woodland, the females were slightly more abundant on the two-foot trap and the males more numerous on the ten-foot trap, but the differences in distribution, although significant, were small. On the moorland, the males were more abundant at two feet and the females at six feet.

Although the general pattern was very similar, there were highly significant differences between the horizontal and vertical distributions of the two races of *C. impunctatus*.

LUMSDEN (W. H. R.). **Probable Insect Vectors of Yellow Fever Virus, from Monkey to Man, in Bwamba County, Uganda.**—*Bull. ent. Res.* **42** pt. 2 pp. 317–330, 1 graph, 18 refs. London, 1951.

There is considerable evidence that the virus of yellow fever is disseminated among monkeys in Bwamba County, Uganda, by *Aëdes africanus* (Theo.) [*R.A.E.*, B **39** 132]. The vector mainly responsible for infection of man is thought to be *A. simpsoni* (Theo.), which also seems to acquire the virus from animals [**37** 150]. In the work here recorded, the method of transfer of the

virus from monkeys to man was examined in relation to the habits of the natives. These and their dwellings are briefly described, and the microclimate within the huts is discussed. Series of 24-hour mosquito catches with human bait were made for five days in and around huts in three localities. Knockdown catches in huts had previously proved unsatisfactory. The results of the bait catches are given in tables, in which catches on the forest floor, in the plantation, in the open and in huts are each divided into the period when men might be present and the period when they were not likely to be. Catches in the forest canopy, where the mosquitos might acquire the infection from monkeys, are given for the 24 hours as a whole, but in considering the acquisition of infection from monkeys on the forest floor or in plantation, only the daylight catch is used, as monkeys do not visit those places in the dark. The species of mosquitos biting in the environments and at the times when the natural hosts would almost certainly be monkeys were compared with those biting at times and in places where natives were likely to be the hosts, and indices representing the numbers biting first in an environment of the first type and a second time in one of the second type were assigned and are given in a table. Theoretical considerations in the assessment are discussed. The extensive immunity among Bwamba monkeys, the short time during which a susceptible animal can infect a vector, and the apparent frequency with which transfer takes place make it almost certain that the vector connecting the forest and the human cycles must be one of those having high indices in this study. The highest index (42) was that for *Aëdes simpsoni* biting twice in plantation. This is a likely environment for transmission, as plantations are often raided by monkeys, and the natives spend a long time in them each day. Indices for *A. simpsoni* in other combinations of environment were only moderate, being 2·1 between plantation and open space, 1·8 between forest floor and plantation, and 1·4 between forest canopy and plantation. The second highest index (27) was that for *A. circumluteolus* (Theo.) biting twice on the forest floor, but transmission is unlikely in this environment as the natives pay only brief visits to the forest. The ability of *A. circumluteolus* to transmit yellow fever experimentally is not known, but this species has never been a suspected vector, as it is scarce in the forest except at ground level. Other species that have been suspected, such as *Mansonia* (*Taeniorhynchus*) *africana* (Theo.) [**35** 67] gave very low indices, and cannot be of more than minor importance. It is suggested that the infection of the natives in such a locality as Bwamba could best be prevented by separating plantation from forest and discouraging the cultivation of crops of which the leaf axils provide breeding places for *A. simpsoni* [**36** 205].

MUSPRATT (J.). **The Bionomics of an African *Megarhinus* (Dipt., Culicidae) and its possible Use in Biological Control.**—*Bull. ent. Res.* **42** pt. 2 pp. 355–370, 1 fig., 35 refs. London, 1951.

The following is based mainly on the author's summary. Living larvae, pupae and adults of *Toxorhynchites* (*Megarhinus*) *brevipalpis* Theo. were transported from southern Natal to Johannesburg to establish an insectary colony. The natural habitat of the species in Natal was small isolated patches of sub-tropical forest, in which the rainfall is 40–50 ins., the mean winter temperature 64°F., the mean summer temperature over 70°F. and the annual range 27–33°F. The larvae, which prey on those of other mosquitos, developed in the leaf axils of *Strelitzia nicolai*, small rot holes in trees and larger ones in *Strelitzia* stumps. They were collected from leaf axils with suction apparatus.

The insectary was a room 9 ft ×8½ ft. and 9 ft. high, which was kept at tropical heat and humidity. Adults were fed on sugar solution, honey and fruit juice. They paired either while at rest or in flight. Females usually oviposited in flight but sometimes while resting on the surface of the water.

In the summer, two females laid about 85 eggs each during the month following emergence, 6–7 days elapsing between emergence and first oviposition. In winter, oviposition was very irregular, although temperature and humidity were kept constant.

When abundant larvae of laboratory-bred *Aëdes aegypti* (L.) were supplied as food, the egg, larval and pupal stages of *T. brevipalpis* normally lasted less than two days, 11–20 days and five days, respectively. Each larva killed 100–200 *aegypti* larvae during life, killing many more than it ate when it was in the late fourth instar. The *brevipalpis* larvae were induced to eat various dead tissues, but of these only minced flies were satisfactory as food. Fourth-instar larvae were kept out of water for 3–4 weeks without food in a damp atmosphere. When subsequently fed, most of them developed normally, but pupation was sometimes suspended for a considerable time. They were sent by post out of water in tubes with damp cotton-wool and filter paper. When in water containing dead leaves, larvae survived for as much as four weeks and some grew to the third instar without any other mosquito larvae as food. Fourth-instar larvae did not attack each other readily but devoured smaller larvae of their own species. Small to medium-sized larvae resorted to cannibalism, particularly in the absence of larvae of other species. There was evidence that fourth-instar *aegypti* larvae occasionally ate first-instar *brevipalpis* larvae.

Attempts to introduce *Toxorhynchites* (*Megarhinus*) *inornatus* (Wlk.) into Hawaii [*R.A.E.*, B **19** 216] and *T. inornatus* and *T.* (*M.*) *splendens* (Wied.) into Fiji [**22** 94] for the control of disease-bearing mosquitos are reviewed and discussed. *T. inornatus* died out in Hawaii, and though *T. splendens* was established and spread in Fiji [**30** 83], it has not become abundant. Moreover, it appears to be of little importance in New Guinea and the Philippines, where it occurs naturally [**38** 12]. *T. brevipalpis*, however, has a shorter life-cycle than *T. splendens* [*cf.* **22** 94 ; **38** 12], and it is concluded that large-scale laboratory breeding leading to the periodical release of large numbers of adults in certain areas would probably be a useful supplement to other control measures, particularly on small islands or in circumscribed areas. Consignments of larvae have been sent by airmail to Hawaii, and an insectary colony has been started there.

SQUIRE (F. A.). **Seasonal Variation in the Incidence of *Trypanosoma vivax* in *Glossina palpalis* (R.-D.).**—*Bull. ent. Res.* **42** pt. 2 pp. 371–374, 1 graph, 7 refs. London, 1951.

Adults of *Glossina palpalis* (R.-D.) collected at Njala, Sierra Leone, in each month of the year from September 1948 to August 1949 were sorted into three age groups according to wing colour and fray, and 3,226 of them were then dissected to determine the percentage infected with *Trypanosoma vivax*. The total percentages for the whole year were 4·3 in all flies and 0·5, 4·7 and 9·1 in the flies of age groups 1, 2 and 3, group 1 being the youngest. There was a marked seasonal fluctuation in infection, the incidence being highest during the months of heavy rainfall (August–October) and lowest in the driest months [*cf. R.A.E.*, B **12** 85]. As the seasonal difference occurred in all age groups, a theory held by Johnson & Lloyd, who worked with *G. morsitans* Westw. and *G. tachinoides* Westw. in Nigeria, that the rise in the rate of infection during the rains was due to an increase in the average age of the fly population at this season was disproved in the circumstances of the present work. Moreover, the proportion of unmated females was shown to be high in the rainy season. The degree of infection in *G. palpalis* in Sierra Leone was about the same as that of *G. tachinoides* in Nigeria [*cf.* **11** 118].

The reason for the seasonal variation in the incidence of infection is discussed, and its importance in interpreting field observations is stressed. Gordon & Davey [**18** 238], who made surveys in July and August, concluded that there had been an important rise in the status of the trypanosome in Sierra Leone since the observations of Yorke & Blacklock [**3** 179], which were made in December and January. Other observers, basing their conclusions on dry-season figures, have pronounced Sierra Leone eminently suitable for cattle-raising. It is not thought that the variation in infection of the flies can be ascribed to changes in the type or abundance of their food, as this is provided mainly by man and domestic animals and is not subject to seasonal change. Its true cause is unknown.

McMahon (J. P.). **The Discovery of the early Stages of *Simulium neavei* in phoretic Association with Crabs and a Description of the Pupa and the Male.**—*Bull. ent. Res.* **42** pt. 2 pp. 419–426, 4 figs., 12 refs. London, 1951.

The eradication of *Simulium neavei* Roub. in 1946 from an area in South Kavirondo, Kenya, by the use of DDT dripping into rivers [*R.A.E.*, B **35** 109–110] left no doubt that the immature stages occurred in the fast-flowing parts of rivers, but they were not discovered until 1950, when larvae and pupae that gave rise to adults of this species were found attached to *Potamon niloticus* (M.-Edw.) in a river near Kericho. About half the crabs of this species examined bore either larvae or pupae. There were 1–10 larvae per crab, but pupae usually occurred singly. Very small larvae were never seen. Very little is known of the habits and distribution of *P. niloticus*, but it appears to confine itself almost exclusively to rivers and the larger tributaries, is found in cascades and other hard beds, and prefers sunlight. Other crabs, which were never found in close association with it, were also examined, but no Simuliids were found on them. *S. neavei* is the only Simuliid to have been found on crabs, but other species of *Simulium* have been found on mayfly nymphs in Kenya and the Belgian Congo.

The technique used in searching the river and breeding out adults is indicated, and the male, pupa and larva of *S. neavei* are described ; a brief description of the female is also included. The effect of the discovery on the eradication of *S. neavei* by DDT treatment is discussed. The current practice has been to treat all rivers and streams fortnightly in chronological order, but it will now be necessary to treat only those in which the crab is found. On the other hand, it will be necessary to treat all contiguous rivers on the same day, and to include the lower reaches of their tributaries, so that Simuliids on migrating crabs do not escape treatment. The existence of large numbers of crabs in previously treated rivers indicates that they are not killed by DDT in the quantities used against Simuliid larvae and that eradication of the crabs is apparently not necessary, though it might prove the easiest way of eradicating the Simuliids should an effective poison be discovered.

Morris (K. R. S.). **The Ecology of epidemic Sleeping Sickness. I. The Significance of Location.**—*Bull. ent. Res.* **42** pt. 2 pp. 427–443, 2 maps, 23 refs. London, 1951.

Outbreaks of the West African form of sleeping sickness, caused by *Trypanosoma gambiense* and transmitted by *Glossina palpalis* (R.-D.) and *G. tachinoides* Westw., are widespread and prolonged, whereas outbreaks of East African sleeping sickness, caused by *T. rhodesiense* and transmitted by *G. morsitans* Westw., are limited and comparatively brief. This is because the suddenness and severity of the illness caused by *T. rhodesiense* prevents

infected men from going to the bush, where *G. morsitans* could acquire infection from them, whereas the protracted and initially mild nature of the disease caused by *T. gambiense* allows ample opportunity for contact between infected persons and its vectors. The realisation of the importance of the part played by infected men in the development of the widespread West African epidemics led to the historical study that is described in this paper.

The following is based on the author's summary. The evidence shows that West African sleeping sickness is not, as has been generally thought, primarily a disease of the forest, where tsetse flies are most abundant, but belongs essentially to the dry country in the north of the savannah woodland zone, where the earliest occurrences and severest outbreaks have been located.

The first mention of sleeping sickness is from the upper Niger (French West Africa) and dates back to the 14th century. By the beginning of the present century, intense though localised epidemics were devastating parts of the Mossi, Grounsi and Lobi country of the upper Volta rivers, and the infection had crossed the Black Volta into the Gold Coast. At this time the disease was unknown on the coast and occurred only sporadically in the forest. A severe trans-Volta epidemic covering 60,000 square miles developed between 1924 and 1940, but was confined to the north of the inland savannah zone with nothing comparable in the forest.

The epidemic spread in three principal ways. It was spread outwards from original foci by the movement of people trying to escape the infection and this led to a concentration of infection round headwaters. It was spread along trade routes by travellers, originally from north to south but subsequently in both directions. There was also a gradual southward shift in the main epidemic zone, apparently resulting from a long-term change in the African climate, which is combining with man's activities to produce a southerly extension of xerophytic vegetation and a regression of forest. The most important spread was that caused by the trading caravans, which must have been continuously introducing infection into the forest ever since sleeping sickness was prevalent in the north, that is for at least 100 years. Infection has been known in the forest for about that period but has never reached epidemic proportions, though conditions in the forest, with *G. palpalis* in contact with every village and path, appear to be ideal for transmission.

This historical evidence and epidemiological data lead to the conclusion that conditions in the forest are not conducive to the development of epidemic sleeping sickness and that the low endemicity found there is maintained by the constant introduction of infection from the true epidemic areas in northern savannah. Tsetse control in the forest would probably be difficult and expensive, and if attempted by means of clearing might lead to the destruction of the forest and to consequences more disastrous than sleeping sickness, but if the sources from which infection is introduced into the forest could be eliminated, the disease there should die out and the tsetse become harmless from the human point of view. With this in mind, the elimination of the disease in the epidemic centres by the eradication of the insect vector is now being tried in the Gold Coast. The validity of the arguments on which the plan was based is already being shown by the high rates of reduction in the epidemic areas and the pronounced lowering of infection in neighbouring, uncontrolled areas, more particularly in the forest region of north-west Ashanti where it is entered by a trade route coming from the previously heavily infected country.

LEESON (H. S.). **Anopheline Larvae collected in Arabia.**—*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 253–255, 1 map, 4 refs. Liverpool, 1948.

Anopheline larvae collected by C. M. Hopkins during a malaria survey in the winter of 1943–44 in that part of Arabia north of the Tropic of Cancer along or

near the coast of the Persian Gulf were found to comprise ten species of *Anopheles*. The areas visited are shown on a sketch map, and brief notes are given on the distribution in them, relative abundance and breeding places of the various species. A key to the fourth-instar larvae of these species and four others that might be expected to occur in the area is appended.

Haddow (A. J.) & Dick (G. W. A.). **Catches of biting Diptera in Uganda, with anaesthetized Monkeys as Bait.**—*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 271–277, 9 refs. Liverpool, 1948.

The following is based on the authors' summary. Three continuous 24-hour catches of blood-sucking Diptera, with anaesthetised monkeys as bait, were made in forest in Bwamba county and in the Entebbe area, Uganda, in 1946. In two cases, the catches were made in the forest canopy only and indigenous species of *Cercopithecus* were used. The third catch was made simultaneously in the canopy, at understorey level and at ground level, with rhesus monkeys (*Macaca mulatta*) as bait.

In all three catches, the most abundant mosquito biting the monkeys was *Aëdes africanus* (Theo.), a species known to be involved in the forest cycle of yellow fever in Uganda [*R.A.E.*, B **39** 132, etc.]. Other prevalent species in forest canopy were *A. apicoargenteus* (Theo.) and the Tabanid, *Chrysops centurionis* Aust. [**38** 141]. It is shown that, with monkeys used as bait, *A. africanus* and, to a smaller extent, *A. apicoargenteus* form a much larger percentage of the catch than when African catchers, using themselves as bait, are employed. *Mansonia* (*Taeniorhynchus*) spp. and *Anopheles gambiae* Giles appear, on the other hand, to attack man more readily than monkeys. It is concluded that *Aëdes africanus* and *A. apicoargenteus* probably feed mainly on monkeys in nature. So far, the authors have recorded 15 species of mosquitos and one Tabanid biting monkeys in Uganda. Of the mosquitos taken biting monkeys in trees, an exceedingly high proportion (86 per cent.) belong to species that normally breed in tree-holes.

Gambles (R. M.) & Coghill (N. F.). **Relapsing Fever in Cyprus.**–*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 288–303, 1 map, 35 refs. Liverpool, 1948.

The following is mainly based on the authors' summary. The history of relapsing fever in Cyprus is discussed. The first case to be diagnosed by the finding of spirochaetes in a blood-film was in 1939, 98 cases occurred among military personnel between August 1941 and April 1943, in all but seven of which spirochaetes were demonstrated in the blood, at least six proved civilian cases were recorded between 1939 and 1943, and many other very probable cases among civilians occurred between 1935 and 1945. The disease appeared at places scattered over the island. Clinically and epidemiologically, it appeared to be of the tick-borne type. *Ornithodoros tholozani* (Lab. & Mégn.) was found in 1942 by Wood & Dixon [*R.A.E.*, B **33** 196] in sites where men had contracted the fever. One or both of the present authors examined 13 localities where proved cases were believed to have been infected, and *O. tholozani* was collected from eight of them, in widely separated parts of the island. Altogether, 29 cases (including six reported by Wood & Dixon and one in a civilian) occurred in sites where the tick was found. It was also found at one site where several unproved civilian cases had occurred. The disease appeared mainly in units encamped in rocky places or on manoeuvres. The ticks were mostly taken in or near dry shallow caves containing what are probably rat-holes. The habitats in which they were found are described. There is some evidence that

O. tholozani may flourish in an environment containing animal excreta. It was once found in a site where it may have been feeding on sheep, but rodents are probably the chief hosts.

The larvae reared from one adult female taken in nature and sent to S. Adler infected guineapigs with relapsing-fever spirochaetes by biting when they first fed. Further evidence that the disease in Cyprus is tick-borne is provided by Dixon, who showed that the blood of a patient with relapsing fever was infective for guineapigs [*loc. cit.*]. Wood & Dixon concluded from this that the spirochaete was *Spirochaeta hispanica*, but as *S. persica* (*sogdiana*) has also been shown to be pathogenic for guineapigs [**17** 18], the authors believe on grounds of vector specificity and geographical considerations that the spirochaete in Cyprus is *S. persica*, though they admit that the concept of vector specificity [**31** 176] is not of universal application. Perfunctory transmission experiments by the authors were all negative. One of them developed a febrile illness, which may have been relapsing fever, 26 days after receiving nine bites from tick larvae from a site where a proved case had recently occurred. No evidence can be offered as to the reservoir of infection in Cyprus. Some ticks were kept alive unfed, sometimes under very adverse conditions, for more than 480 days.

CARTER (H. F.). **Records of Filaria Infections in Mosquitoes in Ceylon.**—*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 312–321, 1 pl., 1 map, 6 refs. Liverpool, 1948.

The following is largely based on the author's summary. Records collected over a period of several years are given of filaria infections in mosquitos caught in different ways in various parts of Ceylon and the Maldive Islands. They are grouped in relation to the known endemicity of human filariasis, caused by *Filaria* (*Wuchereria*) *malayi* and *F.* (*W.*) *bancrofti*, in the localities from which the mosquitos were collected, but it is not suggested that all infections from endemic areas were of human origin.

In known endemic foci of *F. malayi* in the North-Western and Eastern Provinces of Ceylon [*cf. R.A.E.*, B **27** 177], infections were found in 16 species of mosquitos in 1937–40. About two-thirds of the infection occurred in species of the subgenus *Mansonioides* of *Mansonia* (*Taeniorhynchus*). In localities in the North-Western Province where filariasis due to *F. malayi* was slight or absent, mosquitos of the subgenus *Mansonioides* were less prevalent, but a few were found infected. Many infections occurred in other mosquitos, notably in *Anopheles hyrcanus* var. *nigerrimus* Giles, in which an infection rate of 36·8 per cent. was observed at one period. However, the filarial larvae in this mosquito were not *F. malayi* or *F. bancrofti* and were probably derived from buffaloes.

In localities where *F. bancrofti* was endemic (the suburbs of Colombo in the Western Province, examined in 1948, and villages in the most southerly atoll of the Maldive Islands, visited in 1943), the great majority of the infections found occurred in *Culex fatigans* Wied. This species constituted 90 per cent. or more of the mosquitos collected in houses in most of the Colombo suburbs, and was found infected in houses in all but one of the suburban areas visited. The infection rates ranged from 2·2 to 21·0 per cent., with a mean of 8·8. All the mature filarial larvae found in *C. fatigans* showed the three caudal protuberances characteristic of *F. bancrofti*. *C. fatigans* was absent or scarce in collections in cattle-baited traps, and there were very few infections in mosquitos from this source. *C. fatigans* was the only species commonly found in houses on the atoll. No species of *Mansonia* was found there.

Kirk (R.) & Lewis (D. J.). **Taxonomy of the Ethiopian Sandflies (*Phlebotomus*). III. New Species and Records : Alterations and Additions to the Keys.**—*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 322–333, 17 figs., 11 refs. Liverpool, 1948.

This paper supplements the authors' previous two on the species of *Phlebotomus* of the Ethiopian Region [*R.A.E.*, B **37** 137]. It comprises lists of species and varieties that have been described or recorded from the Region since the previous papers were prepared, with notes on their distinguishing characters and distribution, modifications of the keys [*loc. cit.*] to include them, a correction of an error in one of the keys, additional records of the distribution of previously recorded species or varieties, and changes in the nomenclature of a few of them resulting from recent papers on their status or synonymy.

Gordon (R. M.) & Crewe (W.). **The Mechanisms by which Mosquitoes and Tsetse-flies obtain their Blood-meal, the Histology of the Lesions produced, and the subsequent Reactions of the Mammalian Host ; together with some Observations on the feeding of *Chrysops* and *Cimex*.**—*Ann trop. Med. Parasit.* **42** no. 3–4 pp. 334–356, 4 pls., 9 figs., 2 graphs, 44 refs. Liverpool, 1948.

The following is the authors' summary. Flexibility of the proboscis during the act of feeding, similar to that already proved to occur in the mosquito, is shown to occur in *Glossina* and *Cimex*. It is confirmed that the mosquito may feed either directly from a capillary or from a pool of extravasated blood. The second method, referred to as pool feeding, is demonstrated to occur also in *Glossina*, *Chrysops* and *Cimex*. Pool feeding is shown to be the usual method employed by *Glossina* in obtaining a blood-meal, the haemorrhage produced being relatively extensive and large enough for the fly to fill rapidly with blood. The haemorrhage resulting from a tsetse-bite is shown to increase during the first 24 hours after the bite, and in the guineapig to persist for up to 48 hours, during which period it may spread into the muscle layers. After 48 hours the area is invaded by histiocytes, and by 72 hours after the bite the tissue is normal. After the bite of a fly from which the salivary glands have been removed, the haemorrhage is less extensive The immediate reaction to the bite of the mosquito is shown to be due to sensitisation. This reaction is produced and maintained by irregular exposure to the bites, but disappears after continued regular exposure. Desensitisation of the human host to one genus does not necessarily involve desensitisation to another. The delayed reaction to the bite of the mosquito is shown to be caused by the injection of a slow-acting toxic substance in the saliva. This reaction appears after the first exposure, or the first few exposures, to the bite, but disappears after continued regular or irregular exposure. It is suggested that the " immunity " to mosquito bites generally exhibited by natives of the tropics is not a racial characteristic, but is due to the fact that from birth they are regularly exposed to the bites of these insects. It is shown that no reaction is experienced by individuals bitten by *Glossina* for the first time, and that all reactions to uncomplicated tsetse-bites are due to sensitisation. This sensitisation is acquired after as few as five bites. The apparently widespread habit of pool feeding by blood-sucking insects is discussed, and it is pointed out that the majority of parasites introduced by insects feeding in this manner will be deposited, not directly into the circulation, but into the tissues in or near to a pool of extravasated blood, and that such an environment may determine their future development.

Gordon (R. M.), Chwatt (L. J.) & Jones (C. M.). **The Results of a preliminary entomological Survey of Loiasis at Kumba, British Cameroons, together with a Description of the Breeding-places of the Vector and Suggestions for future Research and possible Methods of Control.**—*Ann. trop. Med. Parasit.* **42** no. 3–4 pp. 364–376, 1 pl., 1 map, 4 refs. Liverpool, 1948.

Kumba, in the British Cameroons, is reputed to be one of the most important centres of infestation by *Filaria* (*Loa*) *loa* in Africa. A preliminary investigation was made in June and July 1948 to study the suitability of the area as a loiasis research centre and to determine what lines of research could most profitably be pursued. The results are given in this paper, together with certain observations made in 1947. The area is described. The prevalence of *Chrysops* and the high incidence of *F. loa* both in the fly and in man were confirmed, and it was concluded that the area was particularly well suited for an investigation.

Of 500 adults of *Chrysops* dissected, 480 were *C. silacea* Aust. and 20 *C. dimidiata* Wulp, in both of which *F. loa* develops readily [*cf. R.A.E.*, B **10** 184]. W. G. Davidson had previously observed comparable proportions of the two. No other species of *Chrysops* is known from the area. All were females. Searching vegetation and hanging up cages of females yielded no males, and it is thought that these frequent the high forest canopy. Although most, if not all, of the females had been fertilised and some had oviposited, the ovaries of 492 were immature or only slightly developed. The females probably feed on a wide variety of warm-blooded animals. In Kumba, where cattle are rare, man is likely to be the chief host, but there may be some feeding on monkeys in the forest canopy. Collectors in nine dwellings obtained 571 flies in 943 man-hours. The density was highest in bungalows closely surrounded by bush. The capture of flies in the bush, even very near known breeding-places was comparatively rare. Of the 500 females dissected, 36 were infected with filariae, 20 of them with infective forms. All the infected flies, and 460 of those dissected were taken in European residences.

These figures indicate that at the height of the *Chrysops* season at Kumba, each European would be exposed to the risk of infection with *F. loa* at least once in every five days. The reason why, in view of the high infection rate in *Chrysops*, the proportion of the European and African population showing microfilariae in the blood at any one time is not even higher than it is, is discussed. It is believed that the infections in the flies are practically all derived from man. It is possible that only a small proportion of the filarial larvae deposited on man penetrate the skin and develop, so that the chance of infection is much less than would appear, and infection would tend to be delayed. This view receives support from a study of the incidence of microfilariae in the African population, among whom the rate in adults is much greater than that in children, but not from the limited figures for Europeans. It is also possible that the adult worms sometimes die out or are destroyed, leaving the individual immune, but it is unlikely that immunity is acquired as the proportion of persons showing microfilariae in the blood tends to increase with age. A final possibility is that many of the worms develop and the risk of early infection is as great as it appears, but that evidence of the presence of the adult worms is lacking, because the infection is unisexual, the sexes have failed to meet, or no microfilariae are present when the blood is examined. This suggestion is supported by previous experiments on animals, and by the frequency with which evidence of the presence of adult worms is found in persons in whom repeated blood examinations have failed to reveal microfilariae.

Chrysops larvae were found in densely-shaded streams where slowly moving water passes over a layer of mud covered with decaying vegetation. The breeding sites located are shown on a map. Tentatively suggested control

measures include clearing of bush around streams, canalising the few stagnant portions and using larvicides at places where canalisation is impracticable. It is emphasised, however, that studies of the bionomics of *Chrysops*, the effect of individual measures, and the risk that stream clearing would promote the breeding of *Anopheles gambiae* Giles should precede extensive control activity, as the area is admirably suited to provide much-needed information. In the meanwhile, screening, the use of repellents and the clearing of bush in the immediate neighbourhood of dwellings are recommended to give personal protection. Wide-mesh netting soaked in 60 per cent. dimethyl phthalate as a screening material had no repellent effect. For personal use, a cream containing 30 per cent. dimethyl phthalate gave little or no protection, but a liquid preparation containing 60 per cent. prevented biting for four hours. Lines for future entomological and helminthological investigations are suggested.

[Palimpsestov (M. A.).] **Палимпсестов (М. А.). The clinical differential Diagnosis of Sarcoptic and Psoroptic Mange of Horses.** [*In Russian.*]— *Veterinariya* **25** no. 9 pp. 6–12, 5 figs., 2 refs. Moscow, 1948.

From observations in the Soviet Union in 1944–47 on 210 horses of different breeds suffering to varying degrees from mange caused by *Sarcoptes caballi* Oudm. (*equi* Gerl.) or *Psoroptes equi* (Hering), the author discusses in detail for each of these mites the clinical symptoms, the initial sites of infestation and its subsequent distribution over the body. To assist diagnosis, he summarises characters differentiating infestations by these mites from each other in a table and describes the symptoms of a number of other skin affections of horses with which they may be confused.

[Markov (A. A.), Gil'denblat (A. A.), Kurchatov (V. I.) & Petunin (F. A.).] **Марков (А. А.), Гильденблат (А. А.), Курчатов (В. И.) и Петунин (Ф. А.). A New Vector of the causal Agent of Theileriasis of Cattle (the Tick *Hyalomma scupense* P.Sch.).** (Abstract.) [*In Russian.*]— *Veterinariya* **25** no. 9 p. 13. Moscow, 1948.

Experiments in the Soviet Union have shown that piroplasmosis of cattle caused by *Theileria* can be transmitted by *Hyalomma detritum* Schulze, *H. marginatum* Koch, *H. asiaticum* Schulze & Schlottke, *H. anatolicum anatolicum* Koch and *H. turkmeniense* Olen. (which is considered a synonym of *H. anatolicum excavatum* Koch) [*cf. R.A.E.*, B **31** 105 ; **33** 16 ; **35** 74, 157], and that except in the case of *H. turkmeniense* [**33** 16] the infection is not passed from one generation of the ticks to the next.

Another species, *H. scupense* Schulze, which is widely distributed in the Union, was shown to be a vector in 1948. Unfed adults collected in February and March on cattle in the Province of Krasnodar, North Caucasus, and adults from engorged nymphs taken on the same animals were placed on a healthy cow and a calf in the last week in March, and *Theileria* bodies were found in the blood of these animals 12 and 13 days later. The infection was light and both recovered. Previous investigations in North Caucasus showed that larvae of *H. scupense*, which is a one-host tick, occur on cattle in October, the winter is passed on the animals, and the adults appear early in spring. Cases of piroplasmosis caused by *Theileria* have been observed in cattle in early spring in the Crimea and North Caucasus, outside the main zone of infection, and these are thought to be due to transmission by *H. scupense*.

[Petunin (F. A.).] **Петунин (Ф. А.). *Hyalomma scupense* P.Sch.—a Vector of Nuttalliasis of Horses.** [*In Russian.*]—*Veterinariya* **25** no. 9 p. 14. Moscow, 1948.

In the south of the Province of Krasnodar, farm animals, especially cattle, are heavily infested by *Hyalomma scupense* Schulze [*cf.* preceding abstract], of which the larvae appear in November, infestation reaching its maximum in January–February, and the sexually mature adults in April–May. Several severe cases of equine piroplasmosis caused by *Nuttallia equi* were observed in horses in January 1941, when nymphs and adults of *H. scupense* were the only ticks found on domestic animals. Mass infection developed only after the nymphs had transformed into adults, and it appeared probable that the latter were responsible for transmission. Adults obtained from nymphs collected on infected horses were therefore placed on a healthy foal, and *N. equi* was found in its blood 14 days later and became very numerous after a further two days.

[Masyukov (A. V.).] **Масюков (А. В.). An Enzootic in Fowls caused by Mites.** [*In Russian.*]—*Veterinariya* **25** no. 9 p. 18. Moscow, 1948.

In 1948, fowls at Sochi, on the Black Sea coast of North Caucasus, were found suffering from an affection that caused the death of over 37 per cent. of them, the symptoms being cachexia and drowsiness alternating in some cases with periods of excitement. Autopsy revealed the presence of accumulations of the mite, *Cytoleichus* (*Cytodites*) *nudus* (Vizioli), forming a brown layer on the mesentery, peritoneum and pleura.

[Nikol'skiĭ (S. N.).] **Никольский (С. Н.). The Action of DDT and Hexachlorane on Ixodid Ticks.** [*In Russian.*]—*Veterinariya* **25** no. 9 pp. 29–33. Moscow, 1948.

Experiments were carried out in 1946 and 1947 in Stavropol (North Caucasus) to test the value of DDT and BHC (benzene hexachloride) against Ixodid ticks that infest cattle and, in the laboratory, also against *Argas persicus* (Oken). They were used at various concentrations in aqueous suspension and at a concentration of 5 per cent. in dusts.

In the laboratory tests, larvae of *Boophilus calcaratus* (Bir.), *Dermacentor marginatus* (Sulz.), *Haemaphysalis otophila* Schulze and *Hyalomma scupense* Schulze that were heavily dusted with DDT or BHC became incapable of movement in five and three hours, respectively, and similar results were obtained when larvae of the same species placed on glass came into contact with thin layers of dusts surrounding them. When immersed for one minute in 0·01–0·5 per cent. suspensions, all larvae were immobolised in 60 minutes by 0·1 or 0·5 per cent. BHC, but 10–13 per cent. survived at 0·01 per cent. Larvae were affected by all concentrations of DDT. Engorged nymphs and unfed adults of *H. scupense* thoroughly dusted with BHC or DDT all died in five days, though some of the nymphs had transformed into adults before death. A 0·5 per cent. suspension of DDT or BHC killed all the adults in 48 hours, but again some of the treated nymphs transformed into adults. The BHC and DDT dusts killed all active larvae, nymphs and adults of *Argas persicus* and adults of *D. marginatus* and *Haemaphysalis otophila*, but a suspension of 0·1 per cent. BHC, though effective against *A. persicus*, did not prevent females of *D. marginatus* from depositing viable eggs. A 0·5 per cent. suspension killed adults of *H. otophila* and *D. marginatus*.

In experiments on the time for which BHC would remain toxic to larvae of *B. calcaratus* on the skin of animals, the scrotum of a bull or ram was washed

with a 0·1 per cent. suspension and a bag containing larvae was attached a week later. Examination showed that no larvae became attached for a further week on the bulls and for up to 19 days on the rams, this longer period being probably due to the higher content of fats in the skin of rams. Treatment of a bull infested by adult ticks with a 0·01 per cent. suspension of BHC killed adults that had just transformed from nymphs, but did not affect those that were already feeding ; some of the females laid viable eggs. A 0·1 per cent. suspension of BHC applied in July and August to the neck, the underside of the body and the upper parts of the legs of cattle infested by adults, nymphs and larvae of *Boophilus* killed only the larvae, but a 0·5 per cent. suspension applied twice at an interval of five days was very effective against all stages. The 0·5 per cent. suspension applied in September–October also freed calves from larvae of *Hyalomma scupense* in one experiment and from a heavy infestation by adults of *Haemaphysalis otophila* and *D. marginatus* in another, in which it was applied three times at five-day intervals.

In experiments on winter control, the dusts of DDT or BHC were sometimes applied dry and sometimes mixed with water (1 : 5 or 1 : 10) to prevent waste. A single application of DDT or BHC killed all nymphs and adults of *Hyalomma scupense* on the rump and prevented reinfestation for a fortnight, but up to 10 per cent. of the ticks survived on the abdomen and hind legs, where the hair was thick, and two or even three applications at five-day intervals were necessary. Suspensions of 0·5 per cent. DDT or BHC were also effective, but the treatment had to be repeated when nymphs were present. There were no ill effects on the animals.

BHC and DDT were also effective against lice on cattle, horses, pigs and small laboratory animals, but BHC failed to expel larvae of *Gasterophilus* from the stomach of horses to which doses of 5 or 10 gm. were administered by a stomach tube.

[Egorov (I. A.), Leont'ev (F. M.) & Mashirova (T. P.).] **Егоров (И. А.), Леонтьев (Ф. М.) и Маширова (Т. П.). On the Toxicity of the Preparation DDT to Horses.** [*In Russian.*]—*Veterinariya* **25** no. 9 pp. 33–34. Moscow, 1948.

Investigations of the effect of DDT on horses, carried out in Kazan', showed that 5 per cent. DDT in emulsified solution applied with a brush caused only temporary light depression and decrease in appetite, and no change in condition occurred when this was followed 20 days later by treatment with a 5 per cent. DDT dust at 7 oz. per animal or with 1 per cent. DDT in emulsified solution. In tests on horses suffering from mange, a 5 per cent. DDT dust applied by rubbing it into the skin with a brush three times at intervals of 5–6 days at 7 oz. per animal had no ill effects, and similar treatments against ticks with 5 or 10 per cent. DDT dusts were also harmless, with no evidence of cumulative action.

[Bityukov (P. A.).] **Битюков (П. А.). The Application of the Dust DDT to cure Mange on agricultural Animals.** [*In Russian.*]—*Veterinariya* **25** no. 9 pp. 34–35. Moscow, 1948.

Details are given of experiments in Kazakhstan in April and May 1948 in which DDT dust of unstated concentration proved highly effective against mange mites infesting cattle, horses and sheep. The hair or wool of the animal was ruffled with one hand and the dust applied with the other. The horses and sheep were treated once only, and the cattle once or 2–3 times at intervals

of three days. Itching usually ceased in 6–8 hours, and the skin healed in a few days. Two days after treatment, only single living mites were found in skin scrapings from animals dusted once only, and none on the tenth day.

MARCH (R. B.) & METCALF (R. L.). **Insecticide-resistant Flies.**—*Soap & sanit. Chem.* **26** no. 7 pp. 121, 123, 125, 139, 7 refs. New York, N.Y., 1950.

An account is given of experiments, some of which have already been noticed [*R.A.E.*, B **38** 155], on the comparative resistance to DDT and other insecticides of a laboratory strain of *Musca domestica* L. and two field strains (Bellflower and Pollard) from southern California. It is confirmed that there are two types of resistant strains in the field in southern California, one of which (Bellflower type) is resistant only to DDT and related compounds, and the other (Pollard type) to other chlorinated hydrocarbons, including BHC (benzene hexachloride) and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene]. Neither is resistant to parathion, pyrethrins or allethrin [the synthetic allyl homologue of cinerin I]. Limited tests with a strain from Phoenix, Arizona, showed that it is as resistant as the Pollard strain to DDT and even more resistant to lindane [at least 99 per cent. γ BHC] and dieldrin. Resistance is even more striking at the level for 95 per cent. kill than at that for 50 per cent. kill. In the field, the situation is complicated by the use of different insecticides. Testing of the field population at the site of collection of the Bellflower strain in 1948 showed no appreciable change in resistance in 1949, but in 1950, following the use of BHC since August 1948, not only had resistance to lindane increased about 12 times, but resistance to DDT had increased more than ten times though DDT had not been used. The fundamental basis of resistance is discussed [*cf.* **38** 209, **39** 84, 211]. Tests showed that the laboratory, Bellflower and Pollard strains all had the same degree of susceptibility to 1,1-bis (p-chlorophenyl)-2-nitropropane and 1,1-bis (p-chlorophenyl)-2-nitrobutane. As these compounds are structurally related to DDT, but obviously cannot be metabolised to non-toxic compounds by the same dehydrohalogenation mechanism, the susceptibility to them of the DDT-resistant flies may indicate the importance of a detoxification mechanism in their resistance to DDT. These two compounds have shown promise in the control of DDT-resistant flies in preliminary field studies. Attempts to find synergists or activators for DDT against resistant flies were unsuccessful.

HARRISON (R. A.). **Toxicity to Houseflies of a Flat Oil Paint containing DDT.**—*N.Z. J. Sci. Tech.* **31** (B) no. 2 pp. 24–30, 4 figs., 8 refs. Wellington, N.Z., 1950.

The following is virtually the author's summary. Flat oil paints containing 5, 2·5 and 1 per cent. p,p′ DDT were tested against house-flies [*Musca domestica* L.]. Paint with 5 per cent. DDT was found to be lethal to flies and, under conditions of the tests, retained its full toxicity for 385 days. The paint with 2·5 per cent. DDT gave comparable results, but that with 1 per cent. was not effective. It was found that paint films containing DDT were not toxic to flies to any extent until DDT crystals formed on the surface [*cf. R.A.E.*, B **34** 122; **36** 18; **38** 210]. Once these appeared, knockdown occurred in a relatively short time. Any form of light rubbing or brushing initiated crystal formation, insects walking across the surface being sufficient to start this process. Crystals did not appear until the surface was disturbed in some way.

Jacobson (M.). **Herculin, a pungent insecticidal Constituent of Southern Prickly Ash Bark.**—*J. Amer. chem. Soc.* **70** pp. 4234–4237, refs. Easton, Pa., 1948. **The Structure of Pellitorine.**—*Op. cit.* **71** pp. 366–367, 10 refs. 1949. **Constituents of *Heliopsis* Species. I. Scabrin, an insecticidal Amide from the Roots of *H. scabra* Dunal.**—*Op. cit.* **73** pp. 100–103, 1 graph, 10 refs. 1951.

In these papers, the author describes investigations on the structure of herculin, which was isolated from the bark of *Zanthoxylum clava-herculis* and shown to be N-isobutyl-2,8-dodecadienamide, pellitorine, which was isolated from the roots of *Anacyclus pyrethrum* and shown to be N-isobutyl-2, 6-decadienamide, and scabrin, which was isolated from the roots of *Heliopsis scabra* and shown to be the N-isobutylamide of an isomer or mixture of isomers of octadecapentaenoic acid. Comparison against *Musca domestica* L. showed that herculin had approximately the same order of paralysing action and toxicity as pyrethrins, and that pellitorine was as effective in paralysing action and rather more than half as toxic and scabrin appreciably more toxic than pyrethrins at the same concentration. Herculin was also toxic to mosquito larvae, ticks, several leaf-eating insects and the eggs of the body louse [*Pediculus humanus humanus* L.].

Nash (K. B.). **Biological Tests of Allethrin without a Synergist.**—*Soap & sanit. Chem.* **26** no. 9 pp. 127, 129. New York, N.Y., 1950.

Results are given in tables of tests made in seven laboratories of the comparative effectiveness of natural pyrethrins and allethrin [the synthetic allyl homologue of cinerin I] against flies and cockroaches. Tested at 100 mg. per 100 cc. by the Peet-Grady method against house-flies [*Musca domestica* L.] at three laboratories, allethrin was almost the equivalent of pyrethrins. Results of tests of a series of concentrations by the Peet-Grady method showed that the dosage-mortality curve for allethrin has a steeper slope than that for the pyrethrins [*cf. R.A.E.*, B **39** 24] and crosses it at about 125 mg. per 100 cc. In an aerosol at equal concentrations, allethrin gave a better knockdown of flies than pyrethrins and an equal or better kill [*cf.* **39** 134]. Results of direct-spray tests of oil solutions against German cockroaches [*Blattella germanica* (L.)] have already been noticed [**39** 24]. By the settling-mist method, allethrin appeared to be approximately equivalent to the pyrethrins in the knockdown and kill of *B. germanica* effected at concentrations of 0·1 and 0·2 per cent. Apparently 2–4 times as much allethrin as pyrethrins in oil sprays was needed to give the same kill of American cockroaches [*Periplaneta americana* (L.)] by the direct-spray or settling-mist method. A deposit of allethrin on glass was much superior to one of pyrethrins in giving knockdown and kill of house-flies, but the use of allethrin in this way would be impracticable at present because of its extremely high cost.

Change in TOTA Procedure.—*Soap & sanit. Chem.* **26** no. 9 p. 135. New York, N.Y., 1950.

It is officially announced that the Tentative N.A.I.D.M. Aerosol Test Method for Flying Insects [*R.A.E.*, B **39** 6] has been modified with regard to dosage and now requires a total of $3 \pm 0{\cdot}5$ gm. aerosol mixture to be applied per 1,000 cu. ft. The reduction of dosage by 1 gm. is considered to give a better basis for eliminating unsatisfactory aerosol formulae.

Fuller (H. S.), Murray (E. S.) & Snyder (J. C.). **Studies of Human Body Lice, *Pediculus humanus corporis*. I. A Method for feeding Lice through a Membrane and experimental Infection with *Rickettsia prowazeki*, *R. mooseri*, and *Borrelia novyi*.**—*Publ. Hlth Rep.* **64** no. 41 pp. 1287–1292, 4 refs. Washington, D.C., 1949.

A technique by which *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) was fed through a membrane stretched over the end of a cylinder is described. The membrane is the skin of a chick less than a month old ; chicks 1–7 days old were employed in most of the authors' experiments, and were used as soon as they were killed or after storage for up to a week in a refrigerator. The down is clipped from the skin, and the skin is attached to the cylinder before removal from the bird, by a metal ring slipped under it through a slit. The junction of skin and cylinder is sealed with paraffin wax. Immediately after detachment from the chick, the membrane-covered end of the cylinder is lowered into a beaker containing the blood or other liquid that is to form the meal and, according to its weight, the cylinder is supported or allowed to float on the surface. If the skin has time to dry first, feeding is irregular and unsatisfactory. The beaker is kept in a bowl of water at 36°C. [96·8°F.]. Lice introduced into the cylinder individually or on a piece of felt often began to feed in 5–15 minutes and completed a meal in 30–45 minutes. This technique was successfully used to infect lice with *Rickettsia prowazekii*, *R. p. mooseri* and *Spirochaeta* (*Borrelia*) *novyi* by feeding them on defibrinated human blood mixed with yolk-sac suspensions of the rickettsiae or with an equal volume of heparinised blood of a rat that had been inoculated intra-abdominally with the spirochaete 48 hours before. The principal disadvantage of the method is the difficulty of sterilising skin, but an essentially sterile membrane can be obtained by disinfecting the surface of an egg and allowing the chick to hatch under aseptic conditions. A modification of the technique, in which the membrane is stretched over the shortened stem of a small glass funnel for feeding lice on droplets of blood, is briefly described.

Parker (R. R.), de Prada (J.), Bell (E. J.) & Lackman (D. B.). **Recovery of *C. burnetii* from *H. savignyi* collected in Spain.**—*Publ. Hlth Rep.* **64** no. 50 pp. 1616–1618, 1 ref. Washington, D.C., 1949.

Two strains of *Rickettsia* (*Coxiella*) *burneti* were recovered from 16 adults of *Hyalomma savignyi* (Gerv.) collected on 25th April 1949 from a sheep in the Province of Salamanca. This is the first proof of the occurrence of *R. burneti* in Spain, although the presence of Q fever had been suspected for some time on clinical grounds.

Kuwata (T.), Berge (T. O.) & Philip (C. B.). **A new Species of Japanese larval Mite from a new Focus of Tsutsugamushi Disease in southeastern Honshu, Japan.**—*J. Parasit.* **36** no. 1 pp. 80–83, 4 figs., 5 refs. Lancaster, Pa., 1950.

Trombiculids collected in October and November 1948 from small mammals in an area near Mount Fuji where troops had contracted tsutsugamushi disease in October comprised *Trombicula scutellaris* Nagayo et al., *T. palpalis* Nagayo et al., *T. pallida* Nagayo et al., *T. intermedia* Nagayo et al., *Gahrliepia* sp. and the species here described as *T. fuji*, sp. n., which was found on *Apodemus speciosus*. In collections in the same area in June 1949, additional examples of *T. fuji* were obtained from the same host and from *A. geisha*. In both cases, it was the predominant mite on the living animals. The standard measurements of the holotype and extremes of eight paratypes of *T. fuji* and those of five individuals of *T. intermedia* and five of *T. scutellaris* are given. All three species belong to the " tsutsugamushi group " [*cf. R.A.E.*, B **37** 124].

Riemschneider (R.). **Zur Kenntnis der Kontakt-Insektizide II.** [Contribution to Knowledge of Contact Insecticides II.]—*Pharmazie* Beih. **9** Ergänzungsbd. **1** pp. [2+] 649–800, 19 figs., 11 pp. refs. Berlin, 1950. **Über Kontakt-Insektizide.** [On Contact Insecticides.]—*Pharm. Zentralh.* **87** no. 5 pp. 132–134, 3 refs. Dresden, 1948.

The first of these publications on the chemistry and toxicology of halogenated-hydrocarbon insecticides completes an earlier paper [*R.A.E.*, B **37** 240] and is based largely on the world literature, though it includes the results of some unpublished investigations by the author and his colleagues in Germany. It is divided into two main parts, dealing respectively with materials of the groups of DDT and DDD (α, α-bis(4-chlorophenyl)-β,β-dichloroethane) and of the group of BHC (benzene hexachloride), in which chlordan (M 410) is included. The chlordan was of German manufacture and was evolved in 1945 as a result of a study of substances analogous to cantharidin.

The first part includes accounts of the development of DDT and DDD and analogues of them, methods of preparing DDT, DDD and fluoro-DDT (α,α-bis(4-fluorophenyl)-β,β,β-trichloroethane), the composition of the technical products, and the chemical and physical properties of these materials and isomers and analogues of them, including solubility, stability to light, alkalis, metals and metal salts, and volatility. In connection with the last point, it is shown that the contact toxicity to *Melophagus ovinus* (L.) and *Drosophila melanogaster* Mg. of a series of DDT and DDD analogues was strongly reduced as their melting-points rose above about 150°C.

A section on toxicity to arthropods, largely insects, follows. In tests against various insects in Germany with isomers of DDT, fluoro-DDT and DDD, the order of decreasing effectiveness of the isomers was p,p′, m,p′, o,p′, o,m′ and o,o′. It is further shown that α-(4-chlorophenyl)-β,β,β-trichloroethanol and α-chloro-α-(4-chlorophenyl)-β,β,β-trichloroethane (two by-products in technical DDT) are highly toxic, and even more so against some insects than p,p′DDT, but are unstable and volatile, and also that p,p′fluoro-DDT is more toxic to many insects than p,p′DDT, though less persistent. In tests against *M. ovinus* and *D. melanogaster*, various isomers of fluoro-DDT and fluoro-DDD were more toxic than the corresponding isomers of the chloro compounds.

Further sections in this part contain comparisons of the effectiveness of DDT with that of the older insecticides, data on the rapidity of action of mixtures of DDT with other materials, discussions of the ways in which DDT and DDD are used, the precautions to be taken in practical work and the toxicity of DDT, fluoro-DDT and DDD to warm-blooded animals, and brief reviews of various theories as to the mode of action of DDT and its analogues on insects, and of physical and biological methods of quantitative determination.

The second part contains accounts of the discovery of the toxicity of BHC, its various isomers and analogues of it, their chemical and physical properties, the preparation and composition of technical BHC, and the development of methods of separating its various isomers, increasing the γ content and freeing it from objectionable odour. Work on the toxicity of BHC and its isomers to insects is reviewed. Experiments by the author confirmed the outstanding toxicity of the γ isomer and showed that the β isomer, which has a high melting-point, is practically non-toxic, the ε isomer almost always ineffective, and the α and δ isomers weakly toxic. In tests against *M. ovinus* and *D. melanogaster* with various isomers and analogues of BHC, monofluoro-hexachloro-cyclohexane was nearly as toxic as γ BHC to both insects, and the tri-, tetra-, penta- and hexachloro-methyl-isopropyl-cyclohexanes were fairly toxic to *M. ovinus*, in that order of decreasing effectiveness. Chlordan was moderately toxic and rapid in action against *D. melanogaster*, but less so than γ BHC or fluoro-DDT, and it proved more toxic to *Musca domestica* L. than DDT or DDD. The final

sections deal with the use of BHC in pest control, its effect on bacteria, yeasts and plants, its toxicity to warm-blooded animals, theories as to its mode of action and methods of quantitative analysis of the γ isomer.

The second paper is a summary of the first.

RIEMSCHNEIDER (R.). **L'évolution du " 1068 ", ou " M 410 ", ou " chlordane ".** —*Chim. et Industr.* **64** no. 6 pp. 695–698, refs. Paris, 1950. **Vorläufige Mitteilung über neue Kontakt-Insektizide der Halogenkohlenwasserstoffklasse.** [Preliminary Communication on new Contact Insecticides of the Class of the Halogenated Hydrocarbons.]—*Pharmazie* **3** pt. 3 pp. 115–116, refs. Berlin, 1948.

In the first of these papers, the author compares the processes leading to the discovery of chlordan (M 410) in Germany [*cf.* preceding abstract] and in the United States and emphasises that work in the two countries proceeded independently. In the second, its development in Germany is also described, and it is stated that tests showed both it and a corresponding fluoro-chloro derivative (M 344) to possess high toxicity to insects.

RIEMSCHNEIDER (R.) & OTTMANN (G.). **Über das sogenannte " ζ-Hexachlorcyclohexan " II–III.** [On the so-called ζ-Hexachlorocyclohexane II–III.] —*Z. Naturf.* **5b** pts. 5–6 pp. 246–250, refs., 307–311, 1 graph, refs. Tübingen, 1950.

RIEMSCHNEIDER (R.). **Über das sogenannte " ζ-Hexachlor-cyclohexan " IV.**—*Op. cit.* **6b** pt. 1 pp. 48–49, refs. 1951. **Über das Hexachlor-cyclohexan vom Schmp. 146°C. VI : Die Konfiguration des α-1.1.2.4.4.5-Hexachlorcyclohexans.** [On the Hexachlorocyclohexane with a Melting-point of 146°C. VI : The Configuration of α-1,1,2,4,4,5-Hexachlorocyclohexane.]—*T.c.* pt. 6 pp. 339–340, refs.

In these papers are recorded detailed investigations in Germany on the preparation and identity of a product of the chlorination of cyclohexane that melts at 146°C. and has been claimed by C. Bastiansen and his colleagues (1947) to be a new stereoisomer (the so-called ζ isomer) of benzene hexachloride (1,2,3,4,5,6-hexachlorocyclohexane). It is shown in the third of them to be α-1,1,2,4,4,5-hexachlorocyclohexane and it is stated in the first to have proved weakly toxic to *Drosophila melanogaster* Mg. in laboratory tests and practically non-toxic to some other insects.

RIEMSCHNEIDER (R.). **Über Carboxylverbindungen der Diarylalkane und -alkene II. β,β-Dichlor-α,α-bis-(4-carboxy-phenyl)-äthylen und verwandte Verbindungen.** [On Carboxyl Compounds of Diarylalkanes and -alkenes II. α,α-Bis(4-carboxyphenyl)-β,β-dichloroethylene and related Compounds.]—*Z. Naturf.* **6b** pt. 4 pp. 179–183, refs. Tübingen, 1951.

The preparation of α,α-bis(4-carboxyphenyl)-β,β-dichloroethylene and related compounds is described. In contact tests, none of these analogues of DDT showed any toxicity to *Drosophila melanogaster* Mg. or *Musca domestica* L.

RIEMSCHNEIDER (R.). **Über einige β,β,β-Trichlor-α-(dichlor-phenyl)-äthanole.** [On some α-(Dichlorophenyl)-β,β,β-trichloroethanols.]—*Monatsh. Chem.* **82** pt. 4. pp. 600–606, 12 refs. Vienna, 1951.

The author describes the preparation of various α-(dichlorophenyl)-β,β,β-trichloroethanols and states that α-(3,4-dichlorophenyl)-β,β,β-trichloroethanol showed toxicity when tested against several insects.

Heinz (H. J.). **Neuere Untersuchungen über die Verbreitung von** *Anopheles maculipennis* **in Hamburg.** [Recent Investigations on the Distribution of *A. maculipennis* in Hamburg.]—*Z. angew. Ent.* **31** pt. 2 pp. 304–333, 4 figs., 31 refs. Berlin, 1949.

In view of a post-war increase in the numbers of cases of malaria in various parts of Germany, particularly Berlin [*cf. R.A.E.*, B **36** 160], where war conditions appear to have created new Anopheline breeding places, and the occurrence of the disease in Hamburg [*cf.* **39** 16], where war damage was also severe, a survey of likely breeding sites of *Anopheles maculipennis* Mg. in that city and its suburbs was carried out in 1947. A list of the sites investigated is given, showing the area of water in each and an estimate of the number of larvae per sq. m. Apart from natural ponds, slow-flowing streams and parts of canals, larvae were found in bomb-craters, static water reservoirs and disused air-raid shelters. Rubbish had been tipped into some of these, and the water was discoloured, but conditions were normal for *A. maculipennis* in most of them, the water being still, sunny and clean and covered with algae. The position of each site is shown on a map, with indication of those estimated to contain 200,000 or more larvae per generation. These are considered dangerous from the point of view of transmission ; they were generally rare in the densely populated areas, but were numerous in the eastern and south-eastern districts of the city and in outskirts where cattle were kept. Animal quarters containing many kinds of animals were examined for adults of *A. maculipennis*. These were commonest in pigsties, but their abundance appeared to be governed by a preference for a specific microclimate rather than for a particular type of animal [*cf.* **21** 258, etc.]. Of the collected Anophelines that oviposited in the laboratory, 61·8, 22 and 12·1 per cent. were *A. maculipennis* vars. *messeae* Flni., *atroparvus* van Thiel and *typicus*, respectively, and the rest were *A. claviger* (Mg.) (*bifurcatus*, auct.). The distribution of the varieties of *A. maculipennis* throughout the city is discussed. The summer of 1947 was hotter and drier than the average and favoured the development of the larvae. Observations of the breeding sites showed that development lasted less than 18 days, and there were probably five generations during that year.

It is concluded that there has been little change in the situation with regard to *A. maculipennis* in Hamburg since an earlier survey [**8** 213–214] and little danger of a recrudescence of malaria, but that these mosquitos should be eliminated at least from the breeding places that have sprung up since the war.

Meyer (K. F.) & Holdenried (R.). **Rodents and Fleas in a Plague Epizootic in a rural Area of California.**—*P. R. J. publ. Hlth* **24** no. 3 pp. 201–209, 16 refs. Burlington, Vt., 1949. (Also in Spanish pp. 210–220.)

An ecological study in April 1946 on and near a ranch in Ventura County, California, where rats had been reported to be dying in unusual numbers, established the existence of plague in rats (*Rattus rattus rattus* and *R. norvegicus*), ground squirrels (*Citellus beecheyi*) and a cottontail rabbit (*Sylvilagus audubonii*), and in fleas from *C. beecheyi*, *R. r. rattus* and harvest mice (*Reithrodontomys megalotis*). *Xenopsylla cheopis* (Roths.) was not found ; the fleas identified from *R. r. rattus* comprised 20 examples of *Diamanus montanus* (Baker), three of *Hoplopsyllus anomalus* (Baker), 42 of *Leptopsylla segnis* (Schönh.), a relatively poor vector, 17 of *Nosopsyllus fasciatus* (Bosc) and four of *Echidnophaga gallinacea* (Westw.), and those from *C. beecheyi* comprised 989 of *D. montanus*, 116 of *H. anomalus* and 69 of *E. gallinacea*. The two ground-squirrel fleas (*Diamanus* and *Hoplopsyllus*) thus represented over 25 per cent.

of the fleas on the rats ; it appears certain that they initiated the infection of the rats and not unlikely that they also maintained it in the rat population. These observations provide the first convincing evidence that plague can be spread from wild to domestic rodents.

West (L. S.). **The Housefly.**—9½×6¼ ins., xi[+3]+584 pp., frontis., 176 figs., 55 pp. refs. Ithaca, N.Y., Comstock Publ. Co., Inc. ; London, Constable & Co., Ltd., 1951. Price 63*s*.

About 70 pages of this comprehensive monograph on *Musca domestica* L. are devoted to morphology and anatomy, and some 130 pages to bionomics. On some aspects of the latter, more general data on Muscoids or data on different species are given. In the chapter on parasites, predators, symbionts and commensals, in which the organisms that cause disease in man and warm-blooded animals are included, tabulated lists are given of the bacteria and protozoa recorded in the literature as associated with *M. domestica* and mites that have been taken from it, and published information on Hymenopterous parasites of Muscoids is summarised. The position occupied by *M. domestica* in the animal kingdom is explained in a chapter on taxonomy that is designedly elementary but includes a list of the 204 names that have been given to species and subspecies in the genus *Musca* showing the subgenera to which they belong and the synonymy of those not now considered valid. Brief notes on other flies that frequent houses in the United States are included.

Information on flies and disease in man, and on the function of public health authorities in combating the menace of flies to health (with particular reference to the United States) occupies about 50 pages, and is followed by a chapter on myiasis. This includes a list of the flies known to be involved, compiled from James' information [*R.A.E.*, B **38** 142] and a key to their mature larvae, and reviews of the special relation of the genus *Musca* to the occurrence of myiasis in man and of selected examples of myiasis produced by certain other Muscoids. Miscellaneous subjects dealt with include the world distribution of members of the genus *Musca*, beneficial activities of flies, flies as experimental animals and various techniques. Information on control, which occupies about 80 pages, is divided into discussions of emergency measures for use when the fly population is already somewhat out of hand, permanent methods of preventing breeding, and the uses and dangers of the newer insecticides.

Papers noticed by Title only.

Marks (E. N.). **Studies of Queensland Mosquitoes. Part IV. Some Species of** *Aëdes* **(Subgenus** *Ochlerotatus*) [including two new species].—*Pap. Dep. Biol. Univ. Qd* **2** no. 11, [1+] 41 pp., 16 figs., 16 refs. Brisbane, 1949. [*Cf. R.A.E.*, B **37** 96.]

Field (J. W.), Green (R.) & Byron (F. E.). Eds. **The Institute for Medical Research Kuala Lumpur 1900–1950. Fifty Years of Medical Research in Malaya.**—*Stud. Inst. med. Res. Malaya* no. 25, xiv+389 pp., illus. Kuala Lumpur, 1951.

Downing (R. C.). **Aerosols. A two part Study of Stability Tests of Low Pressure Formulations and Solubility of various old and new Insecticides in Propellents and auxiliary Solvents.**—*Soap & sanit. Chem.* **26** no. 7 pp. 114–115, 117, 119, 139, 4 graphs, 6 refs. New York, N.Y., 1950. [See *R.A.E.*, A **40** 7.]

Rosen (L.), Reeves (W. C.) & Aarons (T.). *Aedes aegypti* **on Wake Island.**—*Proc. Hawaii. ent. Soc.* **13** no. 2 pp. 255–256, 2 refs. Honolulu, 1948.

All available records indicate that before December 1941, when it was occupied by the Japanese, there were no mosquitos on Wake, a coral atoll with a total land area of about 4 sq. miles, made up of three islets, Wake, Peale and Wilkes, and situated over 500 miles from the nearest habitable land. A collection of adults of *Aëdes aegypti* (L.) was received from the atoll in 1947, and larvae and adults from one islet and adults from another, obtained in more extensive collections in January 1948, all proved to be of the same species. There was no fresh water on Wake until an air base was set up in 1935, when storage was begun. Larvae were mainly found in abandoned Japanese cisterns and discarded containers. Barrels and tanks near living quarters had been screened or oiled. The adults bit in brushy areas in daytime but were seen only occasionally in the camp area on calm nights. No mosquito-borne disease has been reported from Wake, but its importance as an international air stopping place makes the eradication of the mosquito desirable. This should not be difficult.

Scudder (H. I.) & Tarzwell (C. M.). **Effects of DDT Mosquito Larviciding on Wildlife. IV. The Effects on terrestrial Insect Populations of routine Larviciding by Airplane.**—*Publ. Hlth Rep.* **65** no. 3 pp. 71–87, 7 figs., 4 refs. Washington, D.C., 1950.

The observations described in this fourth paper of a series [*cf. R.A.E.*, B **38** 58 ; **39** 11] were made in Georgia in 1946 and 1947, in an area where routine applications of DDT at 0·1 lb. per acre were made weekly from aircraft to bodies of water with islands and dykes for the control of mosquito larvae. The amount of DDT reaching the ground varied from 13 to 88 per cent. of the amount discharged where sprays were used and from 1·3 to 18 per cent. of the amount released in aerosols. In 1946, to study maximum effect, marginal study areas were directly treated. Mosquitos, deer flies (*Chrysops* spp.) and sand flies [*Culicoides*] were reduced in numbers by the treatments, but no over-all effect on other kinds of insects was noticed. There was no observed ill effect on honey production in experimental or other colonies of bees of which there were many in the treated areas. Light-trap catches in treated and control areas during the two seasons showed no significant over-all reduction in the insect population of the areas adjoining the treated waters, with the possible exception of Trichoptera.

Parrot (L.) & Durand-Delacre (R.). **Notes sur les phlébotomes. LX. Quelques remarques sur les phlébotomes des terriers de rongeurs du Sud oranais.**—*Arch. Inst. Pasteur Algérie* **26** no. 4 pp. 402–405, 10 refs. Algiers, 1948.

Between 9th May and 10th July 1948, about 100 rodent burrows in Beni Ounif-de-Figuig in the Algerian Sahara were examined for *Phlebotomus* by means of adhesive paper traps at the mouths, and 135 individuals of seven species were taken. Much the most numerous were *P. papatasi* (Scop.) and *P. clydei* Sinton [*cf. R.A.E.*, B **38** 172, 173]. Males were more than twice as numerous as females.

Durand-Delacre (R.). **Quelques observations biologiques sur les phlébotomes de Beni Ounif-de-Figuig (Sahara oranais).**—*Arch. Inst. Pasteur Algérie* **26** no. 4 pp. 406–430, 6 figs., 10 refs. Algiers, 1948.

The following is mainly based on the author's conclusions. The seasonal distribution of the nine species of *Phlebotomus* known to occur at Beni Ounif-de-Figuig in the Algerian Sahara [*cf. R.A.E.*, B **38** 172, 173] and their activity

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at different times of night are discussed on the basis of catches made during the summer of 1947, mainly at light out-of-doors near dwellings. *P. papatasi* (Scop.) and *P. alexandri* Sinton together formed three-quarters of the catch of species that attack man. The former was found throughout the hot season (May–October) and at all hours of the night. The latter appeared suddenly early in August and disappeared equally suddenly in early October. It was taken almost exclusively between dusk and 2 a.m. *P. papatasi*, *P. fallax* Parr., *P. squamipleuris* var. *dreyfussi* Parr. and *P. sergenti* Parr. appeared in early May ; the other species did not appear until after the peak of the hot season. Of these, all except *P. clydei* Sinton were most abundant in the second half of September and all except *P. longicuspis* Nitzu. had disappeared by the middle of October. All species were most plentiful around midnight at the height of the hot season and earlier at the beginning and end of the season. They disappeared almost completely between 2 and 4 a.m. They generally appeared in waves at intervals varying in length from 15 minutes to 2–3 hours. About 18 per cent. of the total catch was composed of males. Engorged females and gravid females about to oviposit, which formed one-fifth of the catch, were attracted to light with unfed females.

SENEVET (G.). **A propos de la nymphe d'***Anopheles ininii*.—*Arch. Inst. Pasteur Algérie* **26** no. 4 pp. 431–432, 1 fig. Algiers, 1948.

The type series of *Anopheles* (*Nyssorhynchus*) *ininii* Sen. & Abonn. included two pupae, and a figure of the dorsal spines was given in the paper in which other stages were described [*R.A.E.*, B **27** 210]. As shown in the figure, the fifth spine is little longer than the fourth and much shorter than the sixth. In other members of the subgenus *Nyssorhynchus* [*cf.* next abstract], the fourth spine is usually short and the fifth nearly as long as the sixth. It is not known whether the short fifth spine in these two pupae is a malformation or a character general in the species.

SENEVET (G.). **Au sujet de quelques nymphes de** *Nyssorhynchus*.—*Arch. Inst. Pasteur Algérie* **26** no. 4 pp. 433–440, 8 refs. Algiers, 1948.

The pupae of the species of the subgenus *Nyssorhynchus* of *Anopheles* resemble one another very closely and have been little studied in view of their lack of characters of diagnostic value. The author published a description of the pupal characters of the subgenus, based on a study of nine species, in 1934 [*R.A.E.*, B **22** 140], and now reviews and modifies the general characters then recognised, reviews the descriptions of pupae of members of the subgenus published since 1934, and gives a tentative key to the pupae of eight species or groups of species. Measurements used are given for six of the species.

MAUGHAN (F. B.), MIZELL (F. M.) & NICHOLS (J. P.). **Further Studies on Aerosol Formulations with Lethane and other Toxicants.**—*Soap & sanit. Chem.* **27** no. 2 pp. 125, 127, 131. New York, N.Y., 1951.

In this paper, a comparison is made of the effectiveness of pyrethrins and allethrin [the synthetic allyl homologue of cinerin I] in aerosols in combination with various synergists and with Lethane 384 [50 per cent. n-butyl carbitol thiocyanate in kerosene] in causing knockdown of flies [*Musca domestica* L.]. Application was at 3 gm. per 1,000 cu. ft. [*cf. R.A.E.*, B **40** 15], and the flies were five days old. The concentrations of insecticides and synergists in 25 formulations and the percentage knockdown obtained with each after 5, 10 and 15 minutes are shown in tables. All of the flies knocked down were dead after 24 hours in all cases. All but three of the formulae contained 2 per cent.

DDT. The standard of comparison was the Tentative Official Test Aerosol (TOTA) [**39** 6] in which the insecticides are 2 per cent. DDT and 0·4 per cent. pyrethrins. Substituting allethrin for the pyrethrins caused a slight increase in knockdown, apparent at all test periods [but *cf.* **39** 134]. Substituting a synergist for part of the pyrethrins or allethrin did not greatly alter ultimate effectiveness but usually decreased knockdown in the first ten minutes. However, when Sulfox-Cide [the n-octyl sulphoxide of isosafrole] was the synergist and pyrethrins the insecticide, early knockdown was very high, though when allethrin was substituted for the pyrethrins, the standard of TOTA was only just reached. Substituting 2 per cent. Lethane 384 for part of the synergist and pyrethrins or allethrin reduced the early knockdown, but 4 per cent. Lethane, which was tried without a synergist and in combination with some synergists but not with Sulfox-Cide resulted in adequate performance. Typical results (knockdown percentages after 5, 10 and 15 minutes) for formulations containing 2 per cent. DDT were 31, 82 and 95 with 0·4 per cent. pyrethrins (TOTA), 46, 88 and 97 with 0·4 per cent. allethrin, 70, 96 and 98 with a formula containing 0·2 per cent. pyrethrins and 1 per cent. Sulfox-Cide, 41, 92 and 100 with one containing 2 per cent. Lethane 384, 0·1 per cent. pyrethrins and 0·8 per cent. Sulfox-Cide, and 24, 88 and 99 with a similar one in which allethrin was substituted for the pyrethrins. The three formulations from which DDT was omitted all contained pyrethrins and 1 per cent. piperonyl butoxide, and all gave 100 per cent. knockdown in 15 minutes. The knockdown percentages in 5 and 10 minutes were 80 and 94 for one containing 0·4 per cent. pyrethrins, 78 and 95 for one containing 0·25 per cent. pyrethrins and 2 per cent. Lethane 384, and 75 and 97 for one containing 0·2 per cent. pyrethrins with 4 per cent. Lethane 384.

Mossop (M. C.). **Report of the Division of Entomology for the Year ending 31st December, 1947.**—*Rhod. agric. J.* **45** no. 3 pp. 230–248 ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1445, 20 pp. Salisbury, S. Rhod., 1948.

Whellan (J. A.). **A Review of the Tsetse Fly Situation in S. Rhodesia, 1948.**—*Rhod. agric. J.* **46** no. 5 pp. 316–325 ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1489, 11 pp. 1949. **Tsetse Fly in S. Rhodesia, 1949.**—*Rhod. agric. J.* **47** no. 5 pp. 416–427, 1 fldg. map ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1547, 13 pp., 1 fldg. map. 1950.

In the third of these reports, a very brief historical review is given of *Glossina* infestation in Southern Rhodesia, and the areas infested in 1850–90, in 1930 and in 1949 are shown on a map. Apart from this, the second and third reports and the section of the first dealing with *Glossina* follow the same lines as the previous ones [*R.A.E.*, B **38** 105, etc.]. There were ten cases of sleeping sickness in the Colony in 1947, nine in 1948 and three in 1949, as compared with 13 in 1946. Satisfactory progress against *Glossina morsitans* Westw. continued in all northern areas in 1947 and 1948. The situation was confused in 1949 by an exceptionally severe drought during which many sources of water previously considered permanent dried up and game (principally elephant) consequently wandered much further than usual and spread the fly. However, the position reverted to normal with the return of the rains. The barrier belt of controlled game destruction, which has enabled 10,000 sq. miles to be reclaimed [*cf.* **30** 8 ; **37** 163], has not been advanced since 1940. The numbers of cattle in the Sebungwe District rose steadily, and trypanosomiasis did not occur among them except for three cases in 1948 and six in 1949 in a locality very near established fly where, until 1947, there had probably been no cattle since 1913. The occurrence of *G. pallidipes* Aust. at Chenga on the Nagupande River, discovered in 1942 [**32** 24], was verified in December 1949. This fly is also known to be

present near the junction of the Sebungwe and Maseme Rivers. *G. morsitans* was not seen in the Hartley area during 1948 or 1949. Cattle were introduced into the Sanyati Native Reserve in the former year, and no trypanosomiasis had been reported in 1949. In the Urungwe District, *G. morsitans* was fairly dense in the Zambesi valley north of the escarpment in all three years. The number of cattle in the Urungwe Native Reserve increased from year to year, and no trypanosomiasis was noted in them.

Eight cases of trypanosomiasis in cattle were seen in Mtoko in 1947. There was a serious outbreak with more than 100 deaths in 1948, but no major outbreak occurred in 1949 and only 21 deaths were recorded. No fly was seen in 1947, but *G. morsitans* was located in Portuguese East Africa about 20 miles from the Mkota Reserve in 1948, and it is concluded it had been carried to the Reserve by elephants and spread the disease. Limited shooting of elephants was accordingly permitted, and the situation improved. The control of elephants continued in 1949.

In the Chipinga area of the Eastern Border, the number of cases of trypanosomiasis of cattle continued to decrease in 1947, but rose in 1948 to 96 cases on nine farms, the highest since 1945. In 1949, the number of cases was 87, but the number of farms involved had increased to 19. Flies caught in Portuguese East Africa on or near the border comprised 96, 83 and 48 examples of *G. pallidipes* in the three years, respectively, 12, 1 and 24 of *G. brevipalpis* Newst. and 16, 20 and 6 of *G. morsitans*. On the Rhodesian side of the border, five examples of *G. pallidipes* and one of *G. brevipalpis* were taken in 1947, four of *G. pallidipes*, one of *G. brevipalpis*, and two of *G. morsitans* in 1948 and two of *G. pallidipes* and two of *G. brevipalpis* in 1949. The main clearing was widened in places in the first two years, and the increasing ease of maintaining it made possible the clearing of a new area of over 3,000 acres in 1949. Further south in the Sabi Valley, there was no improvement in 1947 or 1948. The concentration of *G. morsitans* in Portuguese East Africa near the border was still heavy, and a survey in 1949 indicated that it would not be safe to reintroduce cattle in certain areas where it had been hoped to do so. In Ndanga district, shooting was resumed in 1947, following the finding of two cases of trypanosomiasis in stock.

ROBINSON (G. G.). **Mosquitoes caught in Northern Rhodesia at Balovale and Livingstone.**—*J. ent. Soc. sthn Afr.* **11** pp. 63–67, 6 refs. Pretoria, 1948.

A list is given of 16 species and varieties of *Anopheles* and 62 mosquitos of other genera taken at Balovale and Livingstone, Northern Rhodesia, including 15 previously recorded at Livingstone by Muspratt [*R.A.E.*, B **37** 32], with very brief notes on the distribution or breeding places of a few of them and descriptions of the larva and adults of both sexes of *Aëdes wellmani* (Theo.).

STEYN (J. J.). **DDT Field Trials against Tsetse Fly** (*G. palpalis*) **on Nkuzi Island, Lake Victoria.**—*J. ent. Soc. sthn Afr.* **12** pp. 126–129, 2 refs. Pretoria, 1949.

Field trials with DDT against *Glossina palpalis* (R.-D.) in Uganda [*cf.* also *R.A.E.*, B **36** 100] were carried out in 1945 on a small uninhabited island, 4·65 acres in extent, in Lake Victoria. There were several breeding places along the edge of the island, but a dust impregnated with 4 per cent. DDT applied to these from an aeroplane on 14th February had no effect on the fly, though conditions were very favourable and the dust was effectively deposited. Subsequent tests were made with a solution of 5 per cent. DDT (74 per cent. p,p'isomer) in a mixture of kerosene and cottonseed oil (1 : 3), as previous experiments had indicated that the deposit from this solution is more persistent

on foliage than those from other formulations [but *cf.* **36** 19 ; **38** 23]. It was first applied to an area of one acre at the end of May, and subsequent catches indicated some reduction in the numbers of the fly, but it was concluded that thorough treatment of the feeding grounds would be necessary for effective control. On 29th July, therefore, the solution was applied exclusively to the feeding grounds, especially rocks frequented by crocodiles ; only 3 per cent. of the island had to be treated but a total of 23 lb. DDT was applied. Control was immediate and complete ; no tsetses were seen on the island from the day after treatment up to 17th December, when observations were discontinued, though crocodiles, giant monitor lizards, hippopotamus and cormorants were present as usual. The insect population in general was not adversely affected.

DAHM (P. A.), FOUNTAINE (F. C.), PANKASKIE (J. E.), SMITH (R. C.) & ATKESON (F. W.). **The Effects of feeding Parathion to Dairy Cows.**— *J. Dairy Sci.* **33** no. 10 pp. 747–757, 3 figs., 18 refs. Baltimore, Md., 1950.

Cows that ingested 0·112 mg. parathion per kg. body weight daily for 81 days and two that were fed up to eight times as much at the end of the period showed no changes in health or reproductive ability, and no parathion could be detected in their milk.

DECKER (G. C.) & BRUCE (W. N.). **Where are we going with Fly Resistance ?**— *Soap. & sanit. Chem.* **27** no. 6 pp. 139, 141, 143, 159. New York, N. Y., 1951.

Resistance to insecticides in house-flies [*Musca domestica* L.] may be very variable and induced by the independent or joint action of many independent characters. In the laboratory at Urbana, Illinois, some cases of resistance have been shown to be due to the flies' ability to metabolise DDT almost immediately or decompose it into some harmless components [*cf. R.A.E.*, B **39** 211, etc.], whereas in other highly resistant strains, the DDT is not immediately decomposed. A report from Switzerland indicates that resistance may be due to differences in the pulvillus [**37** 216–217 ; but *cf.* **39** 84]. A strain of house-flies observed by the authors in nature was surviving contact with DDT deposits because the flies had adopted the habit of remaining still after alighting on a surface. Chemical factors, however, appear to be the most important in the development of resistance, at least in Illinois. It seems that the contamination of the media in which the larvae develop is largely responsible for the rapid development of resistance [**39** 39]. This would not be so were adult morphology an important factor. When 80 parts per million DDT were added to breeding media, and resulting adults were exposed in treated cages, little change in susceptibility was noted in the first three generations but F_6 and F_{10} flies from cultures reared in treated medium were 5–10 and over 300 times as resistant as normal flies, whereas F_{10} flies from cultures exposed as adults only showed only 4–5 times the normal resistance.

The amounts of several insecticides needed to cause 50 per cent. mortality in 24 hours when applied topically to various strains resistant to one of them are given in a table. It appears that flies exposed to a mixture of pyrethrins and piperonyl butoxide or to paraoxon [diethyl p-nitrophenyl phosphate] develop resistance very slowly, and the acquisition of a high degree of tolerance for chlorinated hydrocarbons had little effect on the response to these two. All of the chlorinated hydrocarbons tested produced high resistance in a comparatively short time and tended to induce some resistance to each other. In acquiring a high degree of resistance to DDT, flies also acquired fair resistance

to methoxy-DDT (methoxychlor), but only slight resistance to γ benzene hexachloride (as lindane), chlordan and dieldrin [1,2,3,4,10,10-hexachloro-6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethanonaphthalene]. These three were closely related, and resistance to one carried with it fair resistance to the other two. The relationship between chlordan and dieldrin seemed to be particularly close. A mixture of insecticides produced the maximum observed resistance to all of them simultaneously.

Developments in the field have followed the course to be anticipated from the laboratory findings. DDT came into general use in 1945, resistance became significant in 1948, 86 of 94 samples of flies collected at random in Illinois showed significant resistance in 1949, and all of 36 samples showed significant resistance to DDT and 8 per cent. of them to lindane, chlordan and dieldrin in 1950. On two farms on which DDT had become practically worthless in 1948, none was used in 1949 and 1950 and dieldrin and lindane were substituted. Strains of flies were produced in which resistance was acquired to dieldrin and lindane and resistance to DDT was intensified. The inadvisability of using the chlorinated insecticides indiscriminately, as revealed by these circumstances, is stressed. It is tentatively recommended that good sanitation should be the most important step in fly control, that screens and other mechanical devices should be employed to the limits of their practical value, that space-sprays should be used where practical, that the use of mixtures containing several lasting-type insecticides should be avoided, that sprays leaving a toxic deposit should be applied in a way that will not contaminate breeding media, and that if larvicides are used, they should not be closely related chemically to any of the insecticides applied to leave toxic deposits.

Fulton (R. A.), Nelson (R. H.) & Yeomans (A. H.). **Evaluation of Liquefied-gas Aerosols.**—*Soap & sanit. Chem.* **27** no. 8 pp. 129, 131, 7 refs. New York, N.Y., 1951.

Liquefied-gas aerosols in the United States are covered by a patent issued to the Secretary of Agriculture. Non-exclusive licences to operate under it are granted and incorporate an agreement by the licensees to use toxicants and propellents acceptable to the Department of Agriculture in formulae in which the percentage of non-volatile ingredients is not more than 20. The aerosol must also produce a system of particles suspended in air of which 80 per cent. are less than 30 μ in diameter and none more than 50 μ. Formulations for household use must pass a test for knockdown and kill [*R.A.E.*, B **39** 6; **40** 15]. Those for use in greenhouses are approved on the basis of experimental results, and information is also required on plant tolerance.

Particle size can be determined from slides moved through the aerosol fog towards the nozzle by hand, but this method of collection has been modified by the use of an impactor consisting of a small variable-speed motor equipped with a counterbalanced slide holder. The slide revolves on a four-inch radius, and the motor unit is mounted in the centre of a 21-inch tube 36 ins. long, through which air containing the aerosol is drawn by means of a ventilating fan with a capacity of 2,400 cu. ft. per minute. The greatest speed at which the slide can be revolved to obtain a good sample is about 800 revolutions per minute, or 19 miles per hour, but a speed equivalent to 10 m.p.h. is recommended for all types of commercial aerosols. About 0·3 gm. of the aerosol solution should be released four feet from the impactor and drawn past it at approximately 12 m.p.h.

The proper design of nozzles and valves is important, since particle size can be changed by varying the size of the orifice and the structure of the valve. The most practical type of nozzle [*cf.* next abstract] is one that incorporates an expansion chamber between two orifices, the ratio of the inner to the outer

being about 2 : 3, and the restricted inside orifice may be designed as a mitring rod, loose-fitting pin or any device that will give a satisfactory drop in pressure before the solution reaches the expansion chamber. Where a high discharge rate is necessary, a satisfactory aerosol can be produced by means of long capillary tubing ; the resistance to flow of a liquefied gas within such tubing is insignificant when compared with that of other liquids.

FULTON (R. [A.]), YEOMANS (A. [H.]) & ROGERS (E. [E.]). **Design of Nozzles for Low Pressure Aerosols.**—*Soap & sanit. Chem.* Sp. issue *Proc. 36th Mtg chem. Specialities Mfrs' Ass. 1950* pp. 51, 86–87, 1 fig., 1 ref. New York, N.Y., 1950.

FULTON (R. A.). **Insecticidal Aerosols.**—*Soap & sanit. Chem.* **27** no. 9 pp. 141, 143, 145, 4 figs., 5 refs. New York, N.Y., 1951.

In these two papers, somewhat similar accounts are given of investigations on the design of nozzles for producing particles of the requisite sizes in low-pressure liquefied-gas aerosols [*cf.* preceding abstract]. For applying high-pressure aerosols in which dichlorodifluoromethane is the propellent, a nozzle constructed of 0·017-in. capillary tubing was found to give the most satisfactory particle size, and length of the tubing could be varied considerably without changing the particle-size distribution. Capillary tubing can also be used for low-pressure aerosols, but a different length is required for each width of tubing to obtain a minimum particle size. The average median particle diameter of an aerosol released from a solution consisting of 2 per cent. each of DDT and pyrethrum extract (20 per cent. pyrethrins), 5 per cent. each of PD-544C (alkylated naphthalenes) and deodorised kerosene and 43 per cent. each of trichlorofluoromethane and dichlorodifluoromethane, which exerts a pressure of about 35 lb. per sq. in. at 70°F., varied between 16·3 and 50 μ when dispersed with 0·017-in. capillary tubes 0·02–6 ins. long. With capillary tubes 0·0135, 0·017, 0·024 and 0·029 in. in diameter, the most satisfactory lengths were 0·5–1, 0·75–1·5, 1–4 and 4–6 ins., respectively. The discharge rate is associated with the internal diameter and not with the length ; if high discharge rates are necessary, satisfactory aerosols can be produced with large capillary tubing in lengths of 4–6 ins.

As the pressure of an aerosol solution flowing through a capillary tube was found to drop considerably, nozzles comprising combinations of small orifices and expansion chambers were also tested. The most satisfactory had an expansion chamber of 0·008 cu. in. and orifices measuring 0·015 in. at the inlet and 0·021 in. at the outlet [*cf.* preceding abstract]. The delivery rate was about 1 gm. per second at 40 lb. per sq. in., and the difference in pressure between the expansion chamber and the aerosol container was about 5 lb. per sq. in. The spray was continuous, with no dripping at the outlet.

The first paper also contains notes on a method of testing the pressure in the aerosol container and expansion chamber, and the second descriptions and illustrations of various types of expansion-chamber nozzles.

RIEMSCHNEIDER (R.). **Über die Steigerung der Initialtoxizität und Dauerwirkung des β,β,β-Trichlor-α,α-bis-[4-chlor-phenyl]-äthans (p,p′-DDT-Wirkstoff).** [Increasing the initial Toxicity and Duration of Effectiveness of p,p′ DDT.] —*Z. angew. Ent.* **31** pt. 3 pp. 431–440, 1 fig., 16 refs. Berlin, 1950.

In laboratory experiments in Germany in which dusts containing 5 per cent. active ingredient in talc were tested against *Melophagus ovinus* (L.) for immediate effect, the numbers of minutes required for 50 and (in brackets) 80 per cent. knockdown were 35 (52) for p,p′ DDT, 33 (50) for technical DDT,

less than 15 (less than 15) for fluoro-DDT (α,α-bis(4-fluorophenyl)-β,β,β-trichloroethane), 95 (134) for ethyl-DDT (α,α-bis(4-ethylphenyl)-β,β,β-trichloroethane), 58 (103) for α,α-bis(3,4-fluoromethylphenyl)-β,β,β-trichloroethane, 500 (over 730) for α,α-bis(2,4-dimethylphenyl)-β,γ,γ-trichloro-β-propylene and 38 (54) for chlordan (M 410). When the dusts contained 5 per cent. of fused mixtures of p,p'DDT with other halogenated hydrocarbons, the numbers of minutes were 19 (36) for a mixture of DDT, fluoro-DDT and ethyl-DDT, 18 (41) for one of DDT, the fluoromethyl analogue and technical M 414 (octachloroendomethylene-trimethyl-cyclohexane), 36 (54) for DDT with the propylene compound, 23 (40) for DDT, ethyl-DDT and technical M 414, and 29 (48) for DDT, the fluoromethyl analogue and chlordan. In tests for prolonged effect, *Drosophila melanogaster* Mg. was exposed to deposits of dusts containing 3 per cent. active ingredients (p,p'DDT or fused mixtures) 0–35 weeks after application. The numbers of minutes required for 80 per cent. knockdown immediately and (in brackets) after 35 weeks were 35 (53) for DDT, 27 (44) for DDT with ethyl-DDT, 25 (39) for DDT with the fluoromethyl analogue, and 27 (40) for DDT with technical chlordan and technical M 414.

As regards initial toxicity, fluoro-DDT is known to be more effective against many insects than DDT [*cf. R.A.E.*, B **40** 17], but the main reason for the superiority of mixtures with less effective materials is held to be the reduction or elimination of the tendency of DDT to crystallise, so that finer particles and consequently more intimate contact are obtained. This may also be the reason for the superiority sometimes observed of technical DDT over p,p'DDT. Some authors attribute its superiority to the greater effectiveness of some of the impurities in it, but the most active of these (m,p'DDT and α-chloro-α-(4-chlorophenyl)-β,β,β-trichloroethane) are present in extremely small quantities, and in an experiment, the addition of 0·5 per cent. of either of them to p,p'DDT did not increase the effectiveness of dusts containing 5 per cent. toxicant. The effect of the physical form and degree of dispersion of DDT is illustrated by its varying effect on bed-bugs (*Cimex lectularius* L.), which are killed by a 10–15 per cent. dust but are not affected by contact for five days with pure crystalline p,p' DDT.

The increased duration of effectiveness of the mixtures is held to be due to inhibition of the dehydrohalogenation of DDT. It is known that p,p'DDT is easily dehydrohalogenated in the presence of small amounts of certain metallic compounds, whereas the technical product, which usually contains metallic chlorides in small quantities, is less easily decomposed, owing to the inhibiting action of other by-products [*cf.* **35** 197].

The crystalline form and hence the effectiveness of DDT deposits from solutions is also affected by the solvent used, and this is illustrated by further tests with *D. melanogaster*, in which deposits from acetone solutions were more rapid in action than those from ethyl alcohol, ethyl ether or light benzenes [*cf.* **38** 204]. In tests on increasing the effectiveness of deposits of DDT and chlordan from acetone solutions, knockdown of *Calandra granaria* (L.) was increased by about 10–15 per cent. when halogenated phenols (chlorocresols and fluoroxylenes) were added to the dishes in small amounts sufficient to stimulate but not harm the weevils. This increase is not considered sufficient for practical use. The deposits appeared to be less effective in the dark than in normal light.

KLIEWE (H.). **Leitfaden der Entseuchung und Entwesung.** [Guide to Disinfection and Disinfestation.]—3rd revd. edn., viii+126 pp., 62 figs. Stuttgart, F. Enke Verlag, 1951. Price unbound *DM.* 5 ; bound *DM.* 6.60.

In the first part of this handbook, the author deals with hygienic precautions and disinfection with reference to infectious diseases, and in the second, with

animal pests, almost all insects, that are of hygienic importance or are household pests, particularly in Germany. The information in this part comprises brief notes on the bionomics, importance and control of individual species or of groups of species, no scientific names being given. A section on control by fumigation is appended.

TAYLOR (L. R.). **An improved Suction Trap for Insects.**—*Ann. appl. Biol.* **38** no. 3 pp. 582–591, 1 pl., 2 figs., 3 refs. London, 1951.

The suction trap for small flying insects described by C. G. Johnson [*R.A.E.*, B **38** 124] was adversely affected by long exposure to bad weather and liable to damage from handling. Structural improvements chiefly designed to provide additional strength and to give protection from damp and dust were accordingly incorporated, and constructional details are given.

HAWKES (H. A.). **A Study of the Biology and Control of *Anisopus fenestralis* (Scopoli, 1763), a Fly associated with Sewage Filters.**—*Ann. appl. Biol.* **38** no. 3 pp. 592–605, 1 pl., 6 figs., 18 refs. London, 1951.

The larvae of sewage flies are beneficial as scouring organisms in filter beds, and the adults are not very troublesome where interspecific competition prevents any one species from breeding to excess [*cf. R.A.E.*, B **28** 150; **32** 139; **34** 105]. At the Minworth filters near Birmingham, however, *Anisopus fenestralis* (Scop.), which has been present for 30 years, is the dominant sewage fly for the greater part of the year, and the adults sometimes appear in such numbers as to make work on the filter beds almost impossible and become a nuisance in houses nearby. The results are given of laboratory experiments showing that the larval period is considerably prolonged when the food-supply is limited [**32** 140]; a poor food-supply would therefore limit the number of generations and, in consequence, the number of adults. Adult populations of *A. fenestralis* have frequently been assessed by counts of the numbers found under inverted trays placed on the filter bed, but comparisons of counts made in this way under different conditions indicated that the flies migrate under the trays when they require shelter from light and cold so that the counts are relatively higher when conditions on the bed-surface are unfavourable and do not accurately assess the populations in a bed or the rate of egress from it. They can be used to compare the relative effect of different control measures, but counts of the larvae and pupae in the filter beds are regarded as the best means of estimating populations there. Measurements of the seasonal incidence within the filter bed by means of tray traps and above it by means of an adhesive trap comprising four vertical sheets of Perspex arranged in the form of a cross and mounted at a height of 4 ft. above the filter confirmed earlier findings that numbers are highest in spring, low in summer, higher in autumn and relatively high in winter [**32** 140], and showed that the flies were numerous above the filters only when the mean temperature exceeded 52°F., with maximum abundance in June and again in autumn.

Experiments having indicated that control could be obtained by the use of DDT [**35** 102] or BHC (benzene hexachloride), comparative tests were made of the value of BHC applied as a water-dispersible powder and as an emulsion concentrate, both at a rate giving 1·3 lb. γ isomer per acre. The powder or concentrate was diluted with sewage and siphoned for one hour into the sewage being supplied to the filter beds, which were not dosed with sewage for 6 hours before and 17 hours after the treatment. A single application in the autumn of 1948 kept the numbers of flies at a low level for some 60 days, the powder and emulsion causing average reductions of 79 and 63 per cent., respectively. Four applications made during the first six months of 1949 resulted in average

reductions of 70 and 18·5 per cent., respectively, over the whole period ; these less satisfactory results may have been due to the relatively thick film at that time. The applications were followed by an immediate reduction in numbers of flies caused by mortality among those already present, a subsequent increase over a period of 15 days, due to emergence from unaffected pupae, and another reduction lasting about 30 days and caused by mortality among the larvae in the filters at the time of treatment. The immunity of the pupae may be due either to their greater resistance or to their position in the drier regions of the filter, where they are less likely to receive the insecticide. In the second half of 1949, *A. fenestralis* was more abundant in the areas that had been treated than in untreated ones, probably because the previous destruction of larvae had resulted in a better food-supply. The adults are likely to become a nuisance only in late spring and early summer, when large numbers in the filter beds coincide with climatic conditions favouring emergence from them. Since they are controlled most effectively when BHC is applied against the larvae and it is desirable to retain the beneficial feeding activities of the latter for as long as possible, the treatment is best carried out in March and April.

PACKCHANIAN (A. A.). **The Fate of *Leishmania donovani* and *Leishmania tropica* in the Reduviid blood-sucking Insect, *Triatoma*.**—*Amer. J. trop. Med.* **28** no. 4 pp. 537–539, 1 fig., 2 refs. Baltimore, Md., 1948.

The following is substantially the author's summary. The flagellates of *Leishmania donovani* and *L. tropica*, when administered to various species of *Triatoma* with defibrinated rabbit blood from a ball of absorbent cotton-wool, failed to multiply in the bugs or to survive for more than one day. It is concluded that bugs of the genus *Triatoma* are not likely to become vectors of cutaneous or visceral leishmaniasis, should they feed on persons or animals suffering from either disease.

PACKCHANIAN (A. [A.]). **The Fate of some pathogenic Trypanosomes in *Triatoma* and *Ornithodorus*.**—*Amer. J. trop. Med.* **28** no. 4 pp. 541–543, 8 refs. Baltimore, Md., 1948.

Cases of sleeping sickness contracted in Africa are occasionally seen in the United States, and many animals in American zoological gardens harbour various pathogenic trypanosomes. Investigations were therefore made to determine whether Triatomine bugs, which transmit *Trypanosoma cruzi*, and ticks of the genus *Ornithodoros*, which can harbour it for a long time [*cf. R.A.E.*, B **36** 141, etc.], might spread sleeping sickness and animal trypanosomiasis on the American continent. Various species of *Triatoma* were infected with *Trypanosoma brucei*, *T. gambiense* and *T. hippicum*, and *Ornithodoros turicata* (Dugès) with *T. brucei*, *T. gambiense* and *T. rhodesiense*, but the flagellates did not multiply in these arthropods and remained viable in them for only 2–6 days. It is concluded that *Triatoma* or *Ornithodoros* could not play any important part in spreading sleeping sickness or animal trypanosomiasis in America.

WILEY (J. S.) & FRITZ (R. F.). **Tentative Report on expanded Murine Typhus Fever Control Operations in southern States.**—*Amer. J. trop. Med.* **28** no. 4 pp. 589–597, 6 figs., 3 refs. Baltimore, Md., 1948.

Murine typhus is known to have occurred in man over much of the United States, but is principally concentrated in nine States in the south. Its incidence rose steadily from 1929 until 1944 [*R.A.E.*, B **37** 224], and an extensive control programme was begun in 1945, one of the chief features of which was dusting rat runs, burrows and other places likely to harbour rats with 10 per cent. DDT in pyrophyllite or talc to kill their fleas and other ectoparasites. The organisation is described, and the operations with DDT and their effect are discussed.

It was impossible to treat all counties involved, so those that had reported 50 or more cases in 1940–44 or ten or more in 1944 were chosen. Principal emphasis was placed on business establishments in towns, but residential and rural premises were included in some highly endemic areas [*cf.* **39** 108]. It is recommended that DDT dust be applied in two cycles about three months apart between May and October [*cf.* **38** 9]. Work began on a small scale in July 1945, and the programme was in full operation by March 1946. As compared with 1944, there was a differential decrease in typhus cases (dusted counties over non-dusted counties) of about 25 per cent. in the last half of 1945, 44 per cent. in 1946 and 38 per cent. in the first nine months of 1947. The percentages of rats from dusted and (in brackets) non-dusted areas that showed serological evidence of past or present infection with typhus were 30·7 (52) in the last three months of 1945, 23·5 (31·7) in 1946, and 19·7 (20·3) in the first nine months of 1947. It is believed that typhus is not transmitted from rats to man unless at least 15–20 per cent. of the rats in the area show evidence of past or present infection. Data are given on the percentages of rats infested with *Xenopsylla cheopis* (Roths.) and the average number of fleas per rat by months from dusted and undusted premises. The number of rats harbouring *X. cheopis* was decreased by dusting. It was highest in the warm months. The reduction in average numbers of this flea per rat effected by dusting was about 80 per cent. and the seasonal curve was considerably flattened. Similar control of some of the less prevalent fleas and mites was obtained. A close correlation is shown between reported typhus cases and indices of *X. cheopis*. About 70 per cent. control of this flea was still being obtained up to 180 days after dusting [*cf.* **37** 217]. A decrease in reported cases of typhus in the United States from 5,338 in 1944 to an estimated 2,200 in 1947 is believed to be largely due to the control programme, but it is emphasised that while DDT provides a rapid and relatively inexpensive method of controlling typhus, its effects are only temporary and the ultimate objective should be permanent rat control.

Smith (C. N.) & Burnett jr. (D.). **Laboratory Evaluation of Repellents and Toxicants as Clothing Treatments for personal Protection from Fleas and Ticks.**—*Amer. J. trop. Med.* **28** no. 4 pp. 599–607. Baltimore, Md., 1948.

The following is substantially the authors' summary. Laboratory tests were designed for the preliminary evaluation of compounds for application to the clothing as repellents and poisons to give protection from fleas and ticks. It was desired to find materials that would remain effective through several days of wear or repeated washings. The materials named are not necessarily safe for practical use. The less effective compounds were rapidly eliminated in screening tests with small patches of treated cloth. Materials that were effective in the screening tests were further tested by applications to sleeves, stockings or socks, which were worn in pens infested with *Ctenocephalides felis* (Bch.) or *Amblyomma americanum* (L.).

The poisons most effective and durable against both fleas and ticks were dinitro-o-cresol, dinitro-o-sec-butylphenol, benzene hexachloride (95 per cent. γ isomer) and Lethane A-70 (β,β′-dithiocyanodiethyl ether). Nicotine alkaloid gave an exceptionally rapid knockdown of both fleas and ticks. Chlordan, p-tolyl benzyl ether, ω-piperidinododecylbenzene, p-dimethylaminophenyl thiocyanate and n-capric acid were effective against fleas, and 2,4-dinitrophenol, laurylcyclohexylamine, n-amylvalone, p-dimethylaminophenyl thiocyanate and lauryl thiocyanate against ticks. The most effective repellents were the N-(mixed monoamyl)- and N-(n-amyl) imides of 1,2-dicarboxy-3,6-endomethylene-4-cyclohexene, tributyl phosphate, 4-chloro-3,5-xylenol and N-n-butylacetanilide against both fleas and ticks, diethyl phthalate and o-n-hexyloxybenzyl alcohol against ticks but not fleas, and the monocaproic acid ester of

1,5-pentanediol, n-capric acid and p-iso-pentoxybenzyl alcohol against fleas. The last three were not tested against ticks.

RODHAIN (J.). **Susceptibility of the Chimpanzee to *P. malariae* of human Origin.** —*Amer. J. trop. Med.* **28** no. 5 pp. 629–631, 1 ref. Baltimore, Md., 1948.

Having shown that the malaria parasite of the chimpanzee that is morphologically identical with *Plasmodium malariae* can be transmitted to man and produce a quartan malaria [*R.A.E.*, B **32** 89], the author concluded that the parasite (previously known as *P. rodhaini*) is identical with *P. malariae* and that the chimpanzee can be a reservoir of it. This conclusion is supported by the experiments described in this paper in which *P. malariae* from man was transmitted to young chimpanzees by intravenous injection, producing an apparent pauciparasitic infection that did not affect their general condition, and caused typical quartan malaria when transmitted back from chimpanzee to man.

PHILIP (C. B.) & HUGHES (L. E.). **The Tropical Rat Mite, *Liponyssus bacoti*, as an experimental Vector of Rickettsialpox.**—*Amer. J. trop. Med.* **28** no. 5 pp. 697–705, 1 fig., 4 refs. Baltimore, Md., 1948.

An account is given of preliminary tests in which *Liponyssus bacoti* (Hirst) transmitted *Rickettsia akari*, the agent of rickettsialpox [*R.A.E.*, B **37** 165] from mouse to mouse by biting, though it did not appear to be a very efficient vector. Infection was demonstrated in nymphal progeny, indicating transovarial passage of the agent, which was also shown to persist in a colony for at least 34 days and at least for short periods in dead mites.

TRAPIDO (H.). **The Development of a Sprayer for Use with Water Suspensions of DDT in rural Areas of Latin America.**—*Amer. J. trop. Med.* **28** no. 5 pp. 721–739, 16 figs., 4 refs. Baltimore, Md., 1948.

The following is mainly based on the author's summary. DDT deposits from wettable-powder suspensions are more effective against mosquitos than are those from solutions or emulsified solutions when applied to the earthen wall surfaces commonly found in the tropics. Suspensions are also preferable on grounds of economy and facility of transport of the powder. The development of a knapsack-type hand-pumped sprayer for applying water suspensions of DDT is reported. The basic unit modified for the purpose was a stainless steel sprayer devised for use by the United States Army. A brief description of this unit is quoted, and the details relevant to its adaptation for use with water suspensions are discussed and illustrated. The important feature of the new unit is a large-capacity basket-type filter of 40-mesh wire-screen gauze (apertures $0{\cdot}54 \times 0{\cdot}4$ mm.), which is reinforced by an internal cylinder of perforated bronze and placed on the end of the outlet pipe, where it is protected inside the body of the tank but is available for cleaning each time the tank is opened for refilling. The filter prevents particles that will plug the nozzle or cause the gun valve to stick from entering the hose, but has sufficient capacity not to become plugged itself in filtering a tankful of suspension. The sprayer is fitted with interchangeable air-pressure relief valves, one of which may also be used to obtain pressure in the tank from a compressed air source, if this is available. With each group of 6–8 sprayers used by a field crew, there is a combined standpipe, funnel and preliminary filter. This allows the sprayers to be filled to a standard level, leaving adequate air space, and prevents waste.

Downs (W. G.), Colorado Iris (R.) & Gahan (J. B.). **Residual Effectiveness of DDT in the third Season after Application.**—*Amer. J. trop. Med.* **28** no. 5 pp. 741–745, 2 refs. Baltimore, Md., 1948.

Observations on the numbers of Anophelines resting in houses in the smaller of two villages in the State of Morelos, Mexico, treated in May 1945 with 5 per cent. DDT in emulsified solution for the control of *Anopheles pseudopunctipennis* Theo. [*R.A.E.*, B **38** 69] were begun just before spraying was carried out and continued until the end of the 1947 season. In that year, comparison with catches in an untreated village and in a new house in the treated village itself gave evidence that the DDT deposits were still active against the mosquitos. In July, over 300 adults of *A. pseudopunctipennis* were found in the new house and an average of 2·5 per house in 20 treated houses. In October, DDT could still be recovered in significant amounts from the treated surfaces (adobe walls and straw-thatched roofs) by quantitative chemical methods. Tests in which mosquitos were confined in cages against treated and untreated walls showed that they rested on the adobe in preference to the sides of the cage and gave no indication of being repelled by the DDT. In every test, mortality was very much higher among the mosquitos exposed to the treated than among those exposed to the untreated walls. The survival rate among females exposed for 21–25 hours was 64 per cent. on untreated surfaces and only 1 per cent. on treated surfaces.

van der Kuyp (E.). **Mosquito Records of the Netherlands Windward Islands.** —*Amer. J. trop. Med.* **28** no. 5 pp. 747-749, 4 refs. Baltimore, Md., 1948.

In a two-week mosquito survey in the Netherlands Windward Islands (St. Martin, Saba and St. Eustatius) in April 1947, seven species were found on one or more of the islands. *Aëdes aegypti* (L.) and *Culex fatigans* Wied. (*quinquefasciatus*, auct.) were widespread on all three. Autochthonous cases of dengue and of filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* have been reported, but there is no evidence of locally acquired malaria having been present, and no Anophelines were found.

Tarzwell (C. M.). **Effects of DDT Mosquito Larviciding on Wildlife. V. Effects on Fishes of the Routine Manual and Airplane Application of DDT and other Mosquito Larvicides.**—*Publ. Hlth Rep.* **65** no. 8 pp. 231–255, 2 figs., 14 refs. Washington, D. C., 1950.

The following is based on the author's summary of this fifth paper of a series [*cf. R.A.E.*, B **40** 21, etc.], in which an account is given of observations made in the United States over several years on the toxicity to fish of DDT and other insecticides used for the control of mosquito larvae. Among DDT solvents used in making hand applications to small ponds, isopropyl alcohol, ethyl alcohol and acetone were less toxic than kerosene, which in turn was less toxic than No. 2 fuel oil when the rate of application was 1 or 2 U.S. gals. per acre. Velsicol NR-70 was the most toxic solvent tested. The differences in toxicity between solutions of DDT in kerosene and in No. 2 fuel oil were probably insufficient to justify changes in large-scale operations if applications are at 1 U.S. gal. per acre or less. Routine (weekly) treatments with 1 U.S. gal. per acre fuel oil alone caused no observed harm to fish over a period of 14 weeks.

DDT was much more toxic to amphibia, fish and the larger crustacea in stable emulsions than in solutions or dusts. Therefore, emulsions are not recommended for areas having valuable wildlife. Fish were killed by single

applications of DDT solutions at 0·4 lb. DDT or more per acre, but not by single applications of solution at 0·1, 0·05 or 0·025 lb. DDT per acre or of dusts at 0·1 or 0·2 lb. It is believed that dusts at 0·1 lb. DDT per acre can be regularly applied with little or no harm. Routine weekly application of solutions at 0·1 lb. DDT per acre generally caused serious mortality after the tenth application, and their continued use practically eliminated fish. The type of pond greatly influenced the effects of DDT. Some loss was observed after two treatments in one pond, and none during 14 applications in another. Mortality occurred earliest in barren sand-bottomed ponds and was smallest in clay- or silt-bottomed pools having considerable vegetation and organic material on the bottom and receiving muddy water after rains. Generally, however, routine weekly treatments applied from the ground at 0·1 lb. DDT per acre are significantly harmful to fish and are not recommended for Anopheline control where fish are important. No dead fish were seen in ponds treated weekly with 0·025 lb. DDT per acre. Routine application of solutions at 0·05 lb. DDT per acre resulted in harm to fish after 3–18 treatments, usually after about ten. Continued treatment of the whole surface of ponds at this dosage sometimes reduces the fish population drastically, but treatment of limited areas on larger, deeper bodies of water would probably cause no significant harm. In the small ponds where losses occur, fishery values are slight. Oil solutions applied at 0·05 lb. DDT and 1 U.S. gal. solution per acre or dusts at 0·1 lb. DDT per acre are generally recommended to give adequate control of malaria vectors, and aquatic vegetation is not noticeably inhibited by these treatments.

When a 20 per cent. solution of DDT in Velsicol NR-70 was discharged from aircraft as a spray or thermal aerosol at a rate of 0·1 lb. DDT per acre, the amount of DDT reaching the water surface was about five times as much with the spray as with the aerosol. Two sprayed ponds received calculated averages of 53 and 76 per cent., respectively, of the material discharged during 17 and 16 applications, whereas two ponds treated with aerosol received calculated averages of 10 and 12 per cent. of the amount discharged during 15 applications. Observed mortality of fish during three years of treatment with DDT sprays and aerosols from aircraft was not significant. Population studies in treated and untreated areas at the beginning and end of each season revealed no significant decrease in population or change in its composition.

Studies on the effects of DDT and some other new insecticides indicate that they are all toxic to fish if used in large doses. With DDT, the type of pond or water in which it is used and vegetation, organic material, silt and turbidity greatly influence the onset and severity of toxic action. Data are given on the relative susceptibility of various species of fish. At routine dosages of 0·1 lb. per acre, DDD, chlordan and DDT all significantly reduced the fish population of ponds. At 0·05 lb., chlordan and DDD appeared to be somewhat less toxic than DDT. Studies in 1947 indicated that DDD was considerably less toxic than DDT. These three insecticides seemed to have no significant effect on the fish population at dosages of 0·025 lb. per acre. Toxaphene was very toxic, giving complete kills at 0·2 and 0·1 lb. per acre after two and three applications in deep ponds. Kills were obtained at dosages of less than 1 part in 27 million, indicating that toxaphene is as toxic to fish as rotenone, or more so.

DAVIS (T. R. A.). **Filariasis Control in the Cook Islands.**—*N. Z. med. J.* **48** no. 266 pp. 362–370, 13 refs. Wellington, N. Z., 1949.

Filariasis caused by the non-periodic variety of *Filaria* (*Wuchereria*) *bancrofti* is widely distributed in the Cook Islands [*R.A.E.*, B **34** 37–38], affecting 60–90 per cent. of the population, and organised general control measures against the vector, *Aëdes pseudoscutellaris* (Theo.), were instituted in Rarotonga

in August 1946. The control organisation is described. There is no mortality directly attributable to the disease, but loss of working time is considerable, and economic considerations amply justify control.

A. pseudoscutellaris is much the commonest mosquito in the Cook group, and was readily infected with the filaria under experimental conditions, whereas all attempts to infect *Culex fatigans* Wied. and *C. annulirostris* Skuse [*cf.* **34** 38 ; **38** 147] were unsuccessful. *A. aegypti* (L.), the only other mosquito found in Rarotonga, was not tested on account of its rarity. *A. pseudoscutellaris* breeds in all types of water containers in fairly well-shaded areas [*cf.* **34** 39], including tree holes. The adults favour damp places shaded by dense bushes for resting and enter houses only to feed. Their flight-range is probably no more than 150 yards, and is shortened, probably to 40 or 50 yards, in females infected with developing filariae. The adults are most abundant from December to March, when there is enough rain to keep the containers well filled and temperature and relative humidity are high. Females generally bite from soon after dawn until 8 a.m. and from 4 p.m. until dusk, but may do so throughout daylight hours on very dull days. Heavy rain prevents biting but light rain does not.

The measures taken against *A. pseudoscutellaris* were mainly designed to control it in the villages. The plantations did not appear to be an important source of infection. Weekly collection and disposal of garbage was instituted, coconut shells in pig pens and fallen leaves were cleared and burnt weekly, and roof gutters were cleaned regularly. Tree holes were filled, or drainage channels were cut in them. Resting places became of slight importance where breeding places were adequately dealt with, but needed attention elsewhere. Hedges were kept thinly trimmed to admit light and wind, and creepers and bushes were cleared at ground level to reduce shelter and prevent the harbouring of containers under them. The cultivation of suitable plants on land cleared of undergrowth and long grass was encouraged. The two species of *Culex* were adequately controlled by distributing *Gambusia affinis* and by spraying swamps, ditches and pit privies during the wet season with diesel oil. An attempt to establish *Anisops cleopatra* Dist. in Rarotonga failed, but further attempts were to be made. The establishment of this Notonectid is desirable, as it spreads to fresh pools during the wet season, returning to permanent ones during the dry season. The use of sprays to leave toxic deposits in houses was not included in the programme as it was too costly and might divert attention from the basic principle of hygiene. Legislation giving powers of entry and of punishment for failure to take effective measures was passed when the voluntary measures had been proved of value and the natives desired it. In 1948, when naturally infected mosquitos were required for study, none could be found. The measures had greatly improved the level of hygiene in the villages, but it was too early to judge the effect on filariasis by a fresh microfilaria survey.

Nicholson (H. P.) & Vetter (M. H.). **A lethal Trap for capturing small Mammals with their Ectoparasites.**—*J. Parasit.* **36** no. 3 pp. 235–237, 1 fig., 1 ref. Lancaster, Pa., 1950.

Details are given of the construction of a box trap for small mammals, which when sprung explodes a cartridge containing calcium cyanide (Cyanogas A-Dust) so that the trapped animal and its ectoparasites are killed by the hydrocyanic acid gas evolved. Data on performance under field conditions are included. The trap has been successfully used to catch rats and other rodents and compared favourably in catch with traps of two other types. In laboratory tests with artificially infested white rats, all fleas and mites were dead 90 seconds after the traps were sprung and the rats became inert within 30 seconds.

KARTMAN (L.), TANADA (Y.), HOLDAWAY (F. G.) & ALICATA (J. E.). **Laboratory Tests to determine the Efficacy of certain Insecticides in the Control of Arthropods inhabiting Poultry Manure.**—*Poult. Sci.* **29** no. 3 pp. 336–346, 2 figs., 5 refs. Menasha, Wis., 1950.

Laboratory experiments were made during 1947–48 on the effectiveness of certain insecticides against arthropods other than Diptera that are found in poultry manure in Hawaii and act as carriers of endoparasites of fowls. The species used were the cockroach, *Pycnoscelus surinamensis* (L.), the earwig, *Euborellia annulipes* (Lucas), a Tenebrionid, *Alphitobius* sp., and the woodlouse, *Porcellio laevis* Latr. Direct-contact tests with exposure for 10–25 seconds to dusts applied to petri dishes at 4·32 gm. per sq. ft. indicated that BHC (benzene hexachloride) would give adequate kill at rather more than 1 per cent. γ isomer. The only other material of those tested that gave comparable results was chlordan, which was tried against the beetle only.

Subsequent tests were made under simulated natural conditions by applying the insecticides to the surface of 1·5-inch layers of the kind of material found under poultry houses after the arthropods had burrowed into them. Dusts at 4·32 gm. per sq. ft. gave control that was generally correlated with that shown by the same materials when tested by direct contact. The most effective were 5 per cent. BHC (98 per cent. γ isomer) and 1 per cent. parathion, both of which gave complete mortality of the cockroach and beetle. Parathion was not tested against the earwig and woodlouse, but BHC controlled them completely, and also gave high kills of the beetle and cockroach, at 1 per cent. It was more effective than the other insecticides, though chlordan, DDT and combinations of DDT and thiocyanate preparations showed promise. Sodium fluoride (undiluted) and sabadilla were effective only against *P. laevis*, which was controlled by concentrations of 35 per cent. sabadilla or more but not by 10 per cent. Parathion induced the greatest activity in the cockroaches, but considerable activity was caused by methoxy-DDT (methoxychlor) and toxaphene, which were not very toxic, whereas DDT and chlordan, which gave better control, caused only mild activity and none, respectively. Parathion and BHC and to a smaller extent, chlordan, induced deposition of egg cases by cockroaches, but the other materials did not. Generally poor results were obtained with aqueous suspensions applied at 25·92 cc. per sq. ft., but the data indicate that aqueous suspensions of parathion or BHC (98 per cent. γ) at 1 per cent. or less give adequate control. Applied at 25·92 cc. per sq. ft., kerosene solutions of DDT and chlordan at 1 per cent. and acetone solutions of BHC at less than 1 per cent. γ isomer gave complete control in 48 hours of all except the cockroach. The addition of Bladex (50 per cent. hexaethyl tetraphosphate, 45 per cent. petroleum hydrocarbons and 5 per cent. inert ingredients) to DDT in a petroleum-oil solution in the proportion of 1 : 200 failed to increase significantly the toxicity of DDT. Parathion was not available for testing as a solution. Although these tests are not conclusive, the results suggest that parathion, BHC, chlordan and DDT should be tried in the field in the form of oil solutions and water-miscible emulsions, and consideration be given to spreading and penetrating properties as well as comparative toxicity.

PAPERS NOTICED BY TITLE ONLY.

STEYN (J. J.). **The Effect of Cultivation of Swamps on the Anopheline Fauna in Kigezi District, Uganda.**—*J. ent. Soc. sthn Afr.* **11** pp. 76–82, 2 refs. Pretoria, 1948. [See *R.A.E.*, B **37** 163.]

ARMSTRONG (G.), BRADBURY (F. R.) & STANDEN (H.). **The Penetration of the Insect Cuticle by Isomers of Benzene Hexachloride.**—*Ann. appl. Biol.* **38** no. 3 pp. 555–566, 1 fig., 8 refs. London, 1951. [See *R.A.E.*, A **40** 37.]

NEGHME (A.) & ROMÁN (J.). **Present State of Chagas' Disease Surveys in Chile.**—*Amer. J. trop. Med.* **28** no. 6 pp. 835–839, 4 refs. Baltimore, Md., 1948.

The results are given of investigations on Chagas' disease made in Chile between August 1944 and 31st December, 1947. *Trypanosoma cruzi* was found in a total of 1,631 persons and in 12 per cent. of 12,581 people who represented random samples of the population of endemic zones. It was also found in 13·4 per cent. of 3,182 dogs and cats, none of 126 rabbits and guineapigs, 1·6 per cent. of 698 wild mammals, and 44·4 per cent. of 20,614 examples of *Triatoma infestans* (Klug) collected in various endemic areas. *T. infestans* is common in rural dwellings and is the principal vector of *Trypanosoma cruzi* in Chile [*cf.* *R.A.E.*, B **35** 122]. The treatment of 830 houses with 5 per cent. DDT, generally in kerosene, freed 90 per cent. of them from the bugs for three months, and infestation remained low for 6–12 months. Under experimental conditions, γ benzene hexachloride at 1–3 per cent. gave practically as good results as DDT at 5 per cent. The action of chlordan was slight even at 5 per cent.

FAY (R. W.), BUCKNER (A. J.) & SIMMONS (S. W.). **Laboratory Evaluation of DDT residual Effectiveness against House Flies,** *Musca domestica.*—*Amer. J. trop. Med.* **28** no. 6 pp. 877–887, 6 figs., 6 refs. Baltimore, Md., 1948.

The following is almost entirely based on the authors' summary. A laboratory method for evaluating the lasting effectiveness of deposits of DDT against house-flies [*Musca domestica* L.] based on exposure of flies three days old for 15 or 30 minutes, is described, and the results of experiments in which it was used are recorded. Although house-flies were more susceptible than mosquitos to fresh applications of DDT [*cf.* *R.A.E.*, B **37** 237, 238 ; **38** 181], the deposits appeared to deteriorate more rapidly in tests with house-flies than with mosquitos. This reduction in effectiveness was coupled with the presence of the flies themselves, but mechanical removal of the DDT deposits by them was apparently not a significant factor. Adult males were more susceptible than adult females to DDT deposits. Laboratory evaluations showed deposits of 50 mg. DDT per sq. ft. to be markedly less effective than deposits of 100 and 200 mg. When emulsified solutions containing 2·5, 5 and 10 per cent. DDT were applied to paper, plywood and rough wood surfaces to give theoretically equal deposits, results were best on rough wood, and experimental evidence indicated that the type of surface treated was more important than the concentration of the DDT in the spray in influencing lasting effectiveness, though the 2·5 per cent. sprays were better than the others on rough wood and paper. Deposits from 2·5 per cent. DDT as water-wettable suspensions lost effectiveness after a few weeks of weathering, but deposits from 2·5 per cent. DDT as emulsified solutions did not lose effectiveness over the period of observation (24 weeks).

MAIER (J.), RENDTORFF (R. C.) & SUÁREZ (M.). **The Duration of residual Effect of DDT Sprays on Building Materials used in rural Venezuela.**—*Amer. J. trop. Med.* **28** no. 6 pp. 889–894, 2 refs. Baltimore, Md., 1948.

The following is largely based on the authors' summary. Blocks of five building materials commonly used in rural houses in Venezuela were sprayed with 2·5 per cent. DDT in wettable-powder suspension, kerosene solution or emulsified xylene solution at 1 gm. DDT per sq. metre (about 100 mg. per sq. ft.), and tests of the lasting effectiveness of the treatments were made at intervals with wild-caught female mosquitos (nearly all species of *Anopheles*). The blocks were kept between tests on a shelf in a covered shed without walls.

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The materials were adobe (sun-dried mud or clay), bahareque (sun-dried mud or clay mixed with straw), encalado (adobe with a coating of limewash), gamelote (coarse, flat-leaved grass thatch) and paja de cerro (fine, round-leaved grass thatch). In tests with an exposure period of four hours, all sprays gave 100 per cent. kill after 1 month on all surfaces and after ten months and all intervening intervals on encalado [*cf.* *R.A.E.*, B **36** 69 ; **37** 238 ; **38** 182]. On the other surfaces, good kills (72–100 per cent.) were obtained nine months after spraying. In tests with a 15-minute period of exposure, the deposits from the wettable-powder suspension were effective on the solid materials and those from the solution or emulsified solution were not. The solution was also inferior on the thatching materials. The emulsified solution was better on the thatch than on the solid surfaces, but was still in general inferior to the suspension. The suspension still gave complete kill after four months and 94 per cent. kill after 4·5 months on encalado, and it was completely effective after one month but gave poor results after three months on adobe and bahareque. It gave high kills for four months on gamelote and for three months on paja de cerro, but lost effectiveness rapidly after these periods.

As it is not known how long mosquitos rest on sprayed surfaces under natural conditions, it is suggested that to obtain a high mortality of mosquitos entering houses in rural Venezuela, spraying with a suspension of DDT wettable powder at 100 mg. per sq. ft. should be carried out every three months during the season of malaria transmission.

VAN DER KUYP (E.). **Mosquito Records of Aruba and Bonaire.**—*Amer. J. trop. Med.* **28** no. 6 pp. 895–897, 1 fig., 5 refs. Baltimore, Md., 1948.

Sanitary conditions on the islands of Aruba and Bonaire, Territory of Curaçao (Netherlands Antilles) are briefly described. During several short visits to them at different times of the year in 1942–47 five species of mosquitos were found, of which four were common to both islands. The latter included *Aëdes aegypti* (L.) and *Culex fatigans* Wied. (*quinquefasciatus*, auct.), which were also found in the Netherlands Windward Islands [*R.A.E.*, B **40** 33].

TSENG (Sheng) & WU (I). **An ecological Study of Mosquitos in Wuhan Area.**—*Bull. ent. Res.* **42** pt. 3 pp. 527–533, 5 refs. London, 1951.

The Wuhan area in central China is briefly described, and a list is given of nine species of mosquitos collected there between July and December 1947, with notes on the seasonal incidence, feeding habits and breeding places of some of them. The only Anopheline found was *Anopheles hyrcanus* var. *sinensis* Wied., and the only species known to be a vector of dengue was *Aëdes albopictus* (Skuse) ; hospital records indicate that dengue occurred in the area during the Japanese occupation. Females of *Anopheles hyrcanus* var. *sinensis* attack man freely as well as cattle. Monthly mean figures for rainfall, temperature and relative humidity are examined in relation to abundance of adults and larvae of the Anopheline and incidence of malaria. The peaks of malaria incidence and of abundance of larvae and adults all occurred in September, 2–3 months after the peak of rainfall and at an average relative humidity of 66 per cent., almost the lowest for the year. The combined records for 1,937 patients in the three local hospitals in 1947 included 232 cases of malaria. The results of analysis of water from breeding places of mosquitos of three different genera and from a pool in which no larvae were found are recorded. The water from the breeding place of *Anopheles*, which was a rice-field, was muddy yellow with a grassy and earthy smell and a pH of 7·2. It had a residue of 150 mg. per 500 ml. on evaporation and 120 mg. on ignition, and contained 0·36 mg. total organic nitrogen and 2·23 mg. dissolved oxygen per litre.

Peterson (D. G.) & Brown (A. W. A.). **Studies of the Responses of the Female *Aëdes* Mosquito. Part III. The Response of *Aëdes aegypti* (L.) to a warm Body and its Radiation.**—*Bull. ent. Res.* **42** pt. 3 pp. 535–541, 1 pl., 1 fig., 7 refs. London, 1951.

Brown (A. W. A.). **Part IV. Field Experiments on Canadian Species.**—*T.c.* pp. 575–582, 1 pl., 2 refs.

These papers belong to a series [*R.A.E.*, B **39** 189] in which are given the results of investigations in Canada on the factors that attract females of *Aëdes* spp. to warm-blooded hosts. The laboratory experiments described in the first concern the attractiveness of warmth to *A. aegypti* (L.). The following is substantially the authors' summary. The numbers of females touching a billiard ball warmed to 100 or 110°F. were twice as great as those touching one 20° cooler, but attractiveness was reversed when the temperature of the warmer ball reached 120°. The response was eliminated by the interposition of an air-tight window that allowed almost all the radiation to filter through but prevented heat convection. It is therefore concluded that convection is the factor that makes a warm object attractive to the mosquito. This conclusion was supported by an experiment in which the several faces of a warm cube, differing in radiant emissivity but identical in surface temperature, were not significantly different from one another in attractancy (with the exception of black enamel which will be dealt with in a later paper). It is concluded that the failure of Parker [**37** 57] to obtain a positive response to a warm dry object with females of *A. aegypti* was due to the fact that his apparatus allowed only the radiant heat and not the convective heat to reach the mosquitos.

The following is mainly based on the author's summary of the second paper, which is concerned with observations on the responses of adults of several Canadian species of *Aëdes*, studied in the field by means of heated and clothed robots. Moisture on the clothing increased the attractiveness of a warm body 2–4 times when the air temperature exceeded 60°F., but decreased it at lower temperatures. Warmth increased the attractiveness of a body, so that a robot at 98°F. attracted three times as many mosquitos as one at 50–65°F. It may therefore be concluded that moisture is the chief attractant factor when the air temperature exceeds 60°F., and warmth when the temperature is less than 60°F. When a mixture of 10 per cent. carbon dioxide and 90 per cent. air was emitted from the head at 2 litres per minute, corresponding to the normal human exhalation rate of 200 cc. carbon dioxide per minute, 30–60 per cent. more mosquitos were attracted to the body of the robot than to one over which nothing was emitted. The emission of pure carbon dioxide at 2 litres per minute doubled the attractiveness of a warm body as compared with one over which nothing was emitted and was 60 per cent. more attractive than emission of air alone. The vapours of ether and petrol were significantly attractive, but chloroform was repellent. A sweat-soaked jerkin was more attractive than a water-soaked one. Light colours were less attractive than dark ones, and luminescent dyes decreased the attractiveness of cloths. Green was less attractive than red or blue. Glossy satins were less attractive than matt broadcloths. Greenish-khaki nylon cloth was much less attractive than khaki drill or cotton. There was no evidence of interspecific differences in the responses of the mosquitos investigated.

Garside (J. S.) & Darling (H. S.). **Death of Turkeys from Attack by *Simulium griseicolle* Becker in the northern Sudan.**—*Bull. ent. Res.* **42** pt. 3 pp. 583–584, 5 refs. London, 1951.

On 2nd December 1949, two turkeys were tethered at midday to small bushes in the shade at Shambat on the east bank of the main Nile near Khartoum.

At 2 p.m., they were surrounded by a cloud of *Simulium griseicolle* Becker [*cf. R.A.E.*, B **39** 178] but did not seem to be distressed. At 7.30 p.m., both were dead. Their bodies were locked in the boot of a car until next morning, when their feathers were seen to be full of adults of *S. griseicolle*, which appeared to be biting the dead birds. Examination revealed no sign of disease, poisoning or snake or scorpion attack. The skin of the whole body was extensively punctured, and encrusted clotted blood indicated considerable haemorrhage. The internal organs appeared normal except for a complete absence of blood. All the evidence indicated that the birds had died of severe and rapid anaemia following extensive external haemorrhage, presumably due to massive attack by the Simuliid. *S. griseicolle* is always more or less plentiful at Shambat between November and June when the Nile is low, but it was more abundant than usual during the winter of 1949–50. Poultry at Shambat are commonly protected by smudge fires, but these turkeys were not. *S. griseicolle* may be responsible for some deaths usually attributed to snakes or scorpions.

SMITH (Alec). **The Effect of relative Humidity on the Activity of the Tropical Rat Flea** *Xenopsylla cheopis* **(Roths.) (Siphonaptera).**—*Bull. ent. Res.* **42** pt. 3 pp. 585–599, 1 pl., 4 figs., 42 refs. London, 1951.

An account is given of investigations on the reactions of *Xenopsylla cheopis* (Roths.) to uniform and alternative relative humidities. The materials and methods used are described. Whenever the fleas reacted to alternative humidities, they congregated in the drier side of the chamber. The proportion of fleas on the dry side increased when the percentage difference between the alternatives increased and when the alternatives were towards the moister end of the humidity scale. Percentage of fleas moving and speed of movement increased with a rise in humidity. Unfed males, up to one day old, that had been kept at 90 per cent. humidity for five days aggregated intensely in the drier part of the chamber when offered the choice between 65 and 85 per cent. humidity, whereas similar males kept for five days at 70 per cent. humidity reacted weakly. Fleas were more active after exposure for five days to 90 per cent. humidity than to 70 per cent. It is concluded that high activity in wet air contributes towards congregation in the dry side of an alternative chamber and that the degree of aggregation is affected by the difference in activity that occurs in the fleas at different relative humidities. Many of the fleas that were kept at 70 per cent. humidity for five days died, but the survivors nevertheless tended to congregate in the dry side. The intensity of aggregation was not affected by sex, or by the remains of a blood-meal. When 40 fleas were conditioned for five minutes at 50 per cent. humidity and 40 at 90 per cent., and both batches were then offered a choice between these humidities, the numbers that congregated in the drier atmosphere were 36 and 26, respectively. The difference is explained by assuming that a high klino-kinesis (random turning movements where the rate of turning is affected by the intensity of the stimulus) may occur in *X. cheopis*. *Nosopsyllus fasciatus* (Bosc) reacted to alternative humidities in the same way as *X. cheopis*, but its reaction was not affected by preconditioning so that there was no evidence of a high klino-kinesis.

When a roll of lint was dropped into a vessel containing *X. cheopis*, the number that jumped on to it increased with relative humidity, but the number jumping on to a month-old rat showed no clear relationship to humidity. More females than males jumped on to the lint and the rat. The bedding of a colony of 25 male rats was infested with *X. cheopis*. The ratio of the flea index on the rats to the flea population increased with relative humidity, but the ratio for a given sex did not appear to bear a simple relationship to humidity.

Experiments with fleas from which the maxillary palps had been amputated showed that humidity receptors are not confined to the distal three segments of the palps, if indeed there are any there.

The findings are discussed with reference to the literature.

SQUIRE (F. A.). **Observations on Mating Scars in** *Glossina palpalis* **(R.-D.).**—*Bull. ent. Res.* **42** pt. 3 pp. 601–604, 2 figs., 4 refs. London, 1951.

The genital armatures of both sexes of *Glossina palpalis* (R.-D.) are described, and a detailed account is given of copulation, with particular reference to the activity that results in the formation of bilateral scars on the sternum of the sixth abdominal segment of the female. Females mated in the laboratory in small tubes sometimes have no scars, as the flies are undisturbed and do not take to flight with a consequent need for readjustment. The scars are made by the superior claspers of the male. The function of the inferior claspers is also described, and a function for the vermiform appendices is suggested. No mating scars are formed in *G. longipalpis* Wied. and *G. fusca* (Wlk.), the other two species of *Glossina* found in Sierra Leone, owing to the character of the superior claspers. It is thought likely that the scars are confined to members of the *palpalis* group.

Unscarred females are nearly always extremely teneral. From this, it is concluded that pairing takes place within a day or two of emergence. The percentage of unscarred females was therefore adopted as an index of the rate of emergence at any particular time. The error that would attach to such a method was determined by spermatheca dissection. The results of dissection of flies of the three age-groups [*cf. R.A.E.*, B **40** 4], made in July–October 1950, are tabulated. Of the unscarred females (age-group 1), 13·5 per cent. contained spermatozoa, 2·7 per cent. contained ova and none contained a larva. Of the scarred flies of age-groups 1, 2 and 3, 93·9, 98·9 and 95 per cent. contained spermatozoa, 26·7, 29·9 and 27·5 per cent. contained ova and 0·9, 5·7 and 12·5 per cent. contained larvae. It is concluded that the absence of mating scars provides a fairly reliable index of the rate of emergence.

CAMPBELL (R. W. H.). **A preliminary statistical Study of** *Anopheles gambiae* **Giles, based on Maxillary Indices.**—*Bull. ent. Res.* **42** pt. 3 pp. 647–658, 7 figs., 1 ref. London, 1951.

Variation in the maxillary indices of females of *Anopheles gambiae* Giles collected in 1946 in houses in a village in Gambia considered beyond flight-range from possible brackish-water breeding places of *A. melas* Theo. (here treated as a variety of *A. gambiae*) suggested that the species might be composed of two races breeding in fresh water. Data on maxillary indices of adults from the houses and adults emerging from permanent and temporary fresh-water breeding places were examined statistically. Details of the analysis are given. The frequency distribution of the indices in the house samples was found to depart from normality, and the samples were therefore unlikely to have been drawn from a pure population. The mean indices of the fractions of the catch taken in window-traps and in morning spray-catches were 12·91 and 14·74, respectively. The difference between these means was significant, and this lent support to the view that the samples were not drawn from the same population. Adults trapped while emerging over permanent water had a mean index of 15·33 (range 12·5–18) and those trapped over casual pools had a mean index of 13·107 (range 10–15·5). These means do not diverge widely from those found in the two types of house catch and again indicate a mixed population. As the houses were more than two miles from the nearest permanent fresh-water breeding places, whereas during and soon after the rains there were abundant casual pools close at hand, the predominance of the

smaller index group in the window-traps and of the larger index group in the spray-catches, cannot, it is thought, be accepted as evidence of difference in behaviour unless the existence of a fatigue factor causing individuals of the latter group, which have travelled far and exhausted their energy reserves, to rest in houses, can be excluded.

Preliminary study on fresh-water pools showed that certain distinct phases, marked by dominant organisms, give way to one another as a pool ages. Casual water and permanent water can be more accurately defined by reference to the dominant organisms. Within the limits of statistical differentiation, the race of *A. gambiae* having the larger mean maxillary index was not found in water from which photosynthesis, and therefore chlorophyll, was absent, whereas the race with the small mean index was never found in water where photosynthesis had been established.

These findings should make it possible to analyse catches into categories indicating the type of breeding place from which they came. Moreover, if the differences in mean maxillary indices prove to be linked with difference of adult behaviour, this would have to be taken into consideration in assessing the value of insecticidal deposits and mass spraying. Even if the differences in behaviour are due to fatigue, they must still be taken into account in attempting to assess the value of mass spraying.

LANCASTER jr. (J. L.). **One Application Control for Cattle Lice.**—*J. econ. Ent.* **44** no. 5 pp. 718–724, 2 refs. Menasha, Wis., 1951.

Three seasons' experiments on sprays applied to dairy cattle in barns under winter conditions for the control of lice, *Damalinia* (*Bovicola*) *bovis* (L.), *Solenopotes capillatus* End., *Linognathus vituli* (L.) and *Haematopinus eurysternus* (Nitzsch), in New York [*cf.* *R.A.E.*, B **38** 59] are reported. The aim was to find a formulation that would give satisfactory control with one application per season. High pressure sprayers were used and 1·5–2 U.S. gals. spray was applied per mature animal. The materials tested (with quantities per 100 U.S. gals.) were DDT (4 lb. 50 per cent. wettable powder), BHC (benzene hexachloride) (1 lb. powder containing 25 per cent. γ isomer and small quantities of other isomers) and rotenone with sulphur (1 lb. 5 per cent. rotenone and 10 lb. wettable sulphur) in 1948–49 ; chlordan (1 U.S. quart 74 per cent. emulsion) in 1948–49 and 1949–50 ; lindane [containing at least 99 per cent. γ BHC] (1 lb. 25 per cent. powder) and Rotrate (1 lb. wettable powder containing 5 per cent. rotenone and other cubé resins) in 1949–50 and 1950–51 ; and chlordan (1 U.S. quart 72 per cent. emulsion) and Pyrenone T–143 (1 U.S. gal. emulsion concentrate containing 10 per cent. technical piperonyl butoxide and 1 per cent. pyrethrins) in 1950–51. Approximately monthly examinations of specimen animals in each herd were made after spraying until late April or early May. One application of chlordan gave excellent control throughout the season of all species in all years and was the only material to do so. BHC and lindane were less satisfactory when only one application was made but gave excellent results in most cases with two, as did Rotrate, which was superior to lindane in 1950–51 but not in the previous year. Pyrenone was unsatisfactory for seasonal control with one application, particularly against *L. vituli* and *S. capillatus* [*cf.* **38** 60], though the initial kill was very good. DDT and the rotenone and sulphur were unsatisfactory [*cf.* **39** 31].

In no instance were there any toxic effects from the insecticides as used nor any ill effects from spraying dairy cows in the barn during winter, when the average barn temperature was 40°F. The use of chlordan depends largely on the development of a specific analytical technique for determining the amount that is likely to occur in milk after spraying.

Bushland (R. C.) & Hopkins (D. E.). **Experiments with Screw-worm Flies sterilized by X-Rays.**—*J. econ. Ent.* **44** no. 5 pp. 725–731, 2 refs. Menasha, Wis., 1951.

Experiments made in Texas in 1950 showed that adults of *Callitroga hominivorax* (Coq.) (*americana* (Cush. & Patt.)) could be sterilised by X-rays. Irradiation of young adults (less than two days old) sterilised the males, but the highest dosage tried (5,000 roentgens direct irradiation) did not affect the fertility and fecundity of the females. When pupae less than two days old were irradiated, mortality was high, but the highest dosage that some survived had no apparent effect on the fertility or fecundity of the resulting flies. Irradiation of pupae within two days of emergence was the most effective way of producing sterility. Treating such pupae with a dosage of 2,500 roentgens direct irradiation (plus an additional 50 per cent. due to back-scatter and secondary irradiation) sterilised males, and a dosage of 5,000 roentgens reduced the fecundity of females very considerably and allowed only about 2 per cent. or less of the few eggs laid to hatch.

Laboratory observations on the mating habits of *C. hominivorax* showed that males will mate as many as 11 times if virgin females are available. Although mated females remained attractive to males, most females mated only once, even if the mating was with a sterilised male and normal males were later available. Sterilised males were as active as normal males in seeking females, and males sought sterilised females as actively as they did normal ones. When sterilised males were confined with normal males and females in laboratory cages, most of the females laid infertile eggs if the sterilised males were five or ten times as numerous as the normal males. Adding sterilised females to the caged population as well as sterilised males did not affect the result.

To test whether a natural population can be eradicated through the presence of sterilised males, it is suggested that sterilised flies be released in a limited and isolated area of infestation, such as an irrigated valley in the Arizona desert or a small island off the Atlantic Coast. If the attempt was successful, it might be an indication that *C. hominivorax* could be excluded from the eastern United States by releasing sterilised flies among the limited winter population of southern Florida from which the eastern States are reinfested each year.

Moore III (S.), Toczydlowski (A. H.) & Sweetman (H. L.). **Fly Control Experiments in Massachusetts in 1950.**—*J. econ. Ent.* **44** no. 5 pp. 731–733, 4 refs. Menasha, Wis., 1951.

During 1950, when house-flies [*Musca domestica* L.] were present in Massachusetts over an unusually long period but were less abundant than in the two previous years, experiments on their control were made in barns and animal quarters on the University and Experiment Station grounds. In most of the work, continuous vaporisation of lindane [containing at least 99 per cent. γ benzene hexachloride] from electrically heated devices was the method used. No solvents or carrying agents are needed with this procedure, and the barns remain open. Vaporisation at a rate of 0·5 gm. lindane per 20,000 cu. ft. per 24 hours gave excellent control in the less draughty buildings, and a rate of about 1 gm. did so where there was more draught. The vapour treatment did not build up any lasting deposits, but where cattle were retained in the barns and adjoining pens throughout the season, they remained free of horn-flies [*Siphona irritans* (L.)]. Vaporisation and spot-spray treatments were compared in two horse barns similar in size and number of openings. Vaporisation of a total of 61·73 gm. lindane in 124 days maintained excellent control and was more effective than two spot-spray applications of 20 gm. lindane each, the second

four weeks after the first. The latter gave adequate control, but the flies were considerably more abundant than in the other barn during the first six weeks of the test.

A spray of 0·4 per cent. lindane applied to limited areas in a dairy barn gave excellent control, but the cows were treated weekly with pyrethrum and piperonyl butoxide for the control of horn-flies, and this may have contributed to the satisfactory result. A spray of 2·5 per cent. methoxy-DDT (methoxychlor) gave good control in another building, and like the lindane, remained effective for 4–5 weeks. A 3 per cent. DDT spray was used to treat the roosts and outside surfaces of a poultry plant, and fair control resulted. No deleterious effects from the continuous application of lindane vapour were noticed, and no resistance of flies to any of the insecticides was apparent throughout the experiment.

Hoffman (R. A.), Roth (A. R.) & Lindquist (A. W.). **Effect on House Flies of intermittent Exposures to small Amounts of DDT Residues.**—*J. econ. Ent.* **44** no. 5 pp. 734–736, 3 refs. Menasha, Wis., 1951.

When females of a DDT-susceptible laboratory strain of house-flies (*Musca domestica* L.) were exposed for ten minutes to a deposit of 0·2 mg. DDT per sq. ft. on six successive occasions, the percentages killed were 37 with intervals of 7, 16, 7, 16 and 7 hours between the successive exposures, 61 with intervals of 1·75, 1·75, 1·75, 16 and 1·75 hours, and 87 with intervals all of 1 hour. The orresponding figures for flies of a DDT-resistant strain exposed in each instance for 20 minutes to 0·5 mg. per sq. ft. were 17, 30 and 30. The fact that mortality was lowest when the time between exposures was longest, among non-resistant as among resistant flies, is taken to indicate that both can detoxify DDT [*cf. R.A.E.*, B **38** 209; **39** 211] or otherwise reduce its effect provided there are several hours between exposures. Mortality caused by exposure to a heavier deposit of DDT was, however, 3–6 times as high in the flies that had survived the six exposures at the longest intervals as in previously untreated flies of the same strains, indicating that DDT or a toxic byproduct accumulates in the flies.

Knockdown tests with non-resistant females showed that the total exposure time needed to effect knockdown also increased as the interval between exposures was lengthened. In a series of tests with radioactive DDT (containing C^{14}), resistant flies exposed intermittently for a total of seven hours to 5 mg. per sq. ft. had a mortality of 16 per cent., whereas resistant flies exposed continuously for the same time had a mortality of 45 per cent., although the radioactivities of the two lots (and therefore the amounts of DDT absorbed by them) did not differ significantly.

Schoof (H. F.), Siverly (R. E.) & Coffey (J. H.). **Dieldrin as a chemical Control Material on Community Fly Control Programs.**—*J. econ. Ent.* **44** no. 5 pp. 803–807, 3 figs., 2 refs. Menasha, Wis., 1951.

Since 1938, field studies on the possible relation of flies to poliomyelitis have been in progress in the cities of Phoenix (Arizona), Topeka (Kansas), Charleston (West Virginia), Troy (New York) and Muskegon (Michigan). Extensive operations for fly control were initiated in 1949, and though the ultimate objective was improvement of sanitation, it was necessary to rely on insecticides during the early phases of the work. DDT deposits were used but failed to remain effective for more than 1–3 weeks, and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] was therefore tried on a large scale at Phoenix in the autumn of that year. *Musca domestica* L. predominated, and outstanding control was achieved with

dosages of 25 and 50 mg. per sq. ft. In view of this, dieldrin was used in all the towns except Muskegon in 1950 as a toxic deposit from an emulsion. Applications were made to all resting places, including porches, exterior walls of dwellings up to 8–10 ft., exteriors and interiors of animal shelters and vegetation, in the poorer parts of the towns, and to garbage stations and animal shelters in the better residential areas. Each town had a population of about 100,000. There were no harmful effects to the population or domestic animals or to the staff, who took special precautions.

As a supplement to sanitary measures at Charleston and Topeka, 25 mg. dieldrin per sq. ft. (occasionally 50 mg. at sites of particularly heavy infestation) gave satisfactory control throughout the 1950 season. *M. domestica* predominated in Topeka and blowflies of the *Lucilia* (*Phaenicia*) group at Charleston. After initial coverage, occasional retreatment was carried out as required in special areas. At Troy, one application in May and June at 50 mg. per sq. ft. effectively controlled flies (predominantly *Lucilia*) for 7–12 weeks. At Phoenix, however, the results were entirely different ; the effectiveness of a dosage of 25 mg. per sq. ft. in March and April 1950 was short-lived, and subsequent treatment at 50 mg. failed conspicuously to keep fly density down. Field observations and laboratory tests revealed the development of a high degree of resistance to dieldrin in the population of *M. domestica*, about six months after its initial exposure to the chemical. Deposits of DDT and chlordan at 200 mg. per sq. ft. were similarly ineffective.

The need for basic research on the physiology of the resistance mechanism is emphasised. In recommending chemicals for fly control, it is necessary to consider the species of flies present and the locality and also the kinds of insecticides previously used in the area.

Laake (E. W.) & Clark (J. C.). **Tests with the Bowen Vat-side Method for Determination of Toxaphene in Cattle Dips.**—*J. econ. Ent.* **44** no. 5 pp. 811–812, 1 ref. Menasha, Wis., 1951.

During 1949, the amount of toxaphene in dips prepared from three emulsion concentrates was determined periodically through a season of heavy and extended use for the control of ticks on cattle in Texas. The composition of the concentrates is given. Determinations were made both by chemical analysis in the laboratory and by the Bowen vat-side method [in which the concentration of toxaphene in the dip is determined from the specific gravity of an octane (2,2,4-trimethylpentane) extract of a sample to which salt has been added to break the emulsion]. None of the formulations tested disintegrated in the vat during the 1949 dipping season or before it had to be changed because of excessive contamination, and those that were reactivated in the spring of 1950 were still in good condition in early summer. Apparently there had been no loss or change of the toxaphene during the winter. The results obtained by the two methods did not vary by more than 0·05 per cent., and it is concluded that the vat-side method is accurate and reliable. No accurate determination of the concentration of toxaphene in a dip can be made by either method unless the emulsion remains stable in the vat or can be readily and uniformly resuspended.

Blanton (F. S.) & Tani (T. G.). **Typhus Control at Ports in Japan and Korea after World War II.**—*J. econ. Ent.* **44** no. 5 pp. 812–813, 1 ref. Menasha, Wis., 1951.

A brief account is given of the organisation of measures at Japanese ports at the end of the second world war to prevent the spread of typhus by the millions of Japanese and others who were being repatriated at that time. The measures

taken were dusting of the people and their luggage with DDT, and vaccination. Some two million persons were dealt with at 11 ports up to 1st April 1946, by which time the organisation was operating smoothly. Body lice [*Pediculus humanus humanus* L.] were fairly general among the Japanese but not so prevalent as head lice [*P. h. capitis* Deg.], with which 85 per cent. of young schoolgirls were infested. Typhus epidemics in Japan in 1946 and measures taken to control the principal one are briefly discussed [*cf. R.A.E.*, B **37** 224]. Operations at Korean ports are stated to have been similar to those in Japan, but are not discussed.

Travis (B. V.), Smith (A. L.) & Madden (A. H.). **Effectiveness of Insect Repellents against Black Flies.**—*J. econ. Ent.* **44** no. 5 pp. 813–814. Menasha, Wis., 1951.

Miscellaneous tests of repellents against Simuliids made between 1942 and 1945 in Mississippi, New York and Colombia are reported. Evaluation of all materials was based on the time from application to first bite (repellent time). When a test was terminated before a bite was received, its duration was included in obtaining the average repellent time for the series if it increased it. In studies against *Cnephia* (*Eusimulium*) *pecuarum* (Riley) in Mississippi in the spring of 1943, in which repellents were applied to human subjects at about 1 ml. for the arms (elbow to wrist) and 1·5 ml. to the legs (knee to ankle) and to livestock as a thin coating at 150 ml. per animal, all the materials tested, including dimethyl phthalate, 2-ethyl-1,3-hexanediol, Indalone and various mixtures of all three, were effective for more than seven hours on man and four hours on livestock. The longest average repellent time on man (over ten hours) was given by the dibutyl ester of *dl*-malic acid, which was not tested on livestock. The best protection to livestock was given by Indalone. Dimethyl phthalate, ethylhexanediol, Indalone and the 6-2-2 mixture of these repellents were tested by R. Matheson on man against *Prosimulium hirtipes* (Fries) and *Simulium venustum* Say in the Adirondack Mountains of New York, and all were effective for about four hours [*cf. R.A.E.*, B **39** 156]. M. Bates tested the same three repellents (but not the mixture) in Colombia by application to one leg of each test subject several hours before exposure for 10–20 minutes in forested areas where Simuliids were abundant. Ethylhexanediol and dimethyl phthalate gave almost complete protection 2–2·5 hours after application, Indalone being a little less effective, and ethylhexanediol was slightly superior to the other two after about four hours.

Blanton (F. S.). **The Control of Body Lice on Prisoners of War at U.S. Ports during World War II.**—*J. econ. Ent.* **44** no. 5 pp. 814–815, 7 refs. Menasha, Wis., 1951.

The following is substantially the author's summary. Ten ports in the United States were equipped during the second world war to free disembarking prisoners of war from body lice [*Pediculus humanus humanus* L.]. Fumigation with methyl bromide was the method most generally used for treatment of clothing [*cf. R.A.E.*, B **36** 42–45, etc.], but steam was also used at one port. About 500,000 prisoners were disinfested during the war. There is no record of typhus being spread by these prisoners in the United States.

Eads (R. B.). **New Host and Distribution Records for** *Amblyomma inornatum*. —*J. econ. Ent.* **44** no. 5 pp. 819–820, 6 refs. Menasha, Wis., 1951.

Records are given of the finding of *Amblyomma inornatum* (Banks) on wild mammals in Texas and Mexico and on dogs and cats in Texas. Previously recorded hosts include a cow in Texas.

MOGGRIDGE (J. Y.). **Night Activity of Tsetse (*Glossina*) on the Kenya Coast.**—*Proc. R. ent. Soc. Lond.* (A) **23** pt. 10–12 pp. 87–92. London, 1948.

During investigations on the bionomics of the *Glossina* of the Kilifi Region of the Kenya Coast, it was found that *G. austeni* Newst. attacked during darkness [*cf. R.A.E.*, B **30** 7 ; **33** 57 ; **35** 7]. Its night activity was studied in 1937 from February to the end of September, when 44 catching expeditions were made before daybreak. *G. austeni* was active at night throughout the period, but mainly so during the dry season when it showed rush activity by day [**37** 212]. It is thought that the flies have particular difficulty in satisfying their hunger during the short period of daytime activity in the dry season and those that fail to do so are forced to seek food at night. Activity was not increased by moonlight, artificial light, the presence of bait cattle or conspicuous clothing. There was some evidence that only tsetse resting near the path of survey bit and that there was no free movement at night. Night catches were greater in dense savannah than light. There were also indications that smell played a part in attracting the fly at night.

A few individuals of *G. pallidipes* Aust. and occasional ones of *G. brevipalpis* Newst. were taken, but these catches appeared to be fortuitous. Examination of the eyes of all three species by the late H. Eltringham failed to reveal any special power of night vision in any of them.

PERTTUNEN (V.). **Experiments on the Humidity Reactions of some Tsetse Fly Species (Dipt., Muscidae).**—*Ann. ent. fenn.* **16** no. 2 pp. 41–44, 5 refs. Helsinki, 1950.

The results are given of laboratory tests of the humidity preferences of species of *Glossina* that occur in nature in environments differing in degree of humidity. Adults that had recently emerged from pupae kept at about 80 per cent. relative humidity were introduced into an apparatus, having a graduated relative humidity of 20–100 per cent. and kept there for 6–8 days. They were introduced where the humidity was 35–50 per cent. All the species investigated clearly avoided the driest zones of the gradient, but were slow to gather at the moist end. The majority of adults of *Glossina fuscipleuris* Aust., which is normally associated with rain forest, congregated at 50–100 per cent. relative humidity on the first day of the experiment, those of *G. palpalis* (R.-D.) which is found near lakes and rivers, on the second, and of *G. morsitans* Westw., which occurs in deciduous thicket or savannah woodland, often far from any permanent water, on the fourth. The tests with the first two species were carried out at 21–22°C. [69·8–71·6°F.], and those with the third at 17–20°C. [62·6–68°F.].

In a series of experiments in an alternative chamber with a humidity range of 46–73 per cent., adults of *G. morsitans* and *G. tachinoides* Westw. and adults of *G. morsitans* preconditioned for five days in a desiccator showed no reaction to humidity in tests lasting for nine, five and three days, respectively. The reactions of tsetse flies to humidity are compared and contrasted with those of *Musca domestica* L. [*R.A.E.*, B **37** 57] and mosquitos [**26** 191].

[KORSHUNOVA (O. S.) & PETROVA-PIONTKOVSKAYA (S. P.).] **Коршунова (О. С.) и Петрова-Пионтковская (С. П.). On the Vector of Marseilles Fever.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N. S.) **68** no. 6 pp. 1151–1153, 1 graph, 5 refs. Moscow, 1949.

Several strains of the rickettsia of Marseilles fever were isolated in 1946–47 from adults of *Rhipicephalus sanguineus* (Latr.) resulting from nymphs taken on dogs in the Crimea [*cf. R.A.E.*, B **27** 240]. In experiments, a batch of such adults was fed on a guineapig, which developed fever six days later, the

engorged females oviposited after being kept for 3–5 days, and when the resulting larvae and nymphs were fed on guineapigs, both of the latter subsequently developed fever. Symptoms typical of Marseilles fever were obtained when brain from the second animal was injected into two healthy guineapigs and further passages made. Numerous rickettsiae were found in smears of the salivary glands, stomach and sex organs of adult females from the infected nymphs, but none in those of the males.

In further tests, the rickettsia was found to be pathogenic to mice and rabbits, but not to white rats or *Sigmodon hispidus*. The mice were infected intranasally by means of a suspension of the ticks or of the organs of guineapigs used for serial passages, and the rabbits by intratesticular injection of a suspension of guineapig organs.

[Pogosyantz (E. E.) & Sazonova (O. N.).] **Погосянц (Е. Е.) и Сазонова (О. Н.). On the Possibility of the Transmission by blood-sucking Insects of the Agent causing Carcinoma of the mammary Glands in Mice.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N. S.) **69** no. 1 pp. 81–83, 13 refs. Moscow, 1949.

Workers on mammary carcinoma in mice have shown that the infectious agent (milk factor) present in mice of high-tumour strains occurs not only in the milk and various tissues but also in the blood, and though evidence on the extent to which it occurs in the blood is conflicting, the finding suggested that it might be transmitted by blood-sucking insects. Experiments on its transmission by *Nosopsyllus* (*Ceratophyllus*) *fasciatus* (Bosc) were accordingly made in 1947–48, the fleas being transferred in large numbers from mice of a high-tumour strain to young mice (2–30 days old) of a strain naturally free from mammary carcinoma but susceptible to the milk factor. Transmission was considered to have occurred if pre-cancerous changes (hyperplastic nodules) could be demonstrated in the mammary glands when the mice were 8–9 months old and had completed a period of lactation, and positive results were obtained in six mice out of 32, with mammary carcinoma in two of the six. Controls, which included mothers and sisters of test mice, were negative.

In preliminary tests with *Cimex lectularius* L. and mouse lice, none of 12 and two of 12 test mice, respectively, were positive, but the positive results with the lice are not considered conclusive, as controls were not available.

Injection of 0·1–0·2 cc. blood of the high-tumour strain gave positive results in only 7 of 20 mice, indicating that the occurrence of the milk factor in the blood is irregular, and that high rates of transmission by blood-sucking insects could not be expected. The prick of a needle wetted with the blood gave a positive result in one mouse out of 12.

[Dolmatova (A. V.).] **Долматова (А. В.). Morphological Adaptations of Sandflies** (*Phlebotomus*) **to dry and humid Climate.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **69** no. 2 pp. 285–288, 1 graph, 5 refs. Moscow, 1949.

The species of *Phlebotomus* of the Soviet Union are xerophilous, whereas those of tropical regions favour moist conditions. Since similar differences among species of *Anopheles* have been shown to be related to the size of the spiracles [*cf. R.A.E.*, B **31** 188 ; **37** 27], this character was investigated in sandflies of several species from Rio de Janeiro and Belém in Brazil which have an annual rainfall of rather more than 1,000 and 2,000 mm., respectively, and from various parts of the Soviet Union. The length of the fore spiracle expressed as a percentage of the dorsal length of the mesothorax was taken as the spiracle index. The indices of the Rio and Belém sandflies were 7·8 and

8·29. Those for the Soviet sandflies and, in brackets, the annual rainfall where they were collected were 6·64 and 6·73 for two batches of *P. papatasi* (Scop.) (119–183 and 341 mm.), 6·93 for species of the group *P. minutus* (Rond.) (119-183 mm.), 7·14 for *P. perniciosus* var. *tobbi* Adl. & Thdr. (518 mm.) and 7·43 for *P. major* Annan. (545 mm.).

P. papatasi and the species of the *minutus* group are resistant to dryness. The world distribution of *P. perniciosus* var. *tobbi* and *P. major* is outlined and it is pointed out that although they occur in dry places in the Soviet Union and elsewhere, they are chiefly associated with sea coasts, and it may be assumed that in countries with a dry climate they are able to exist only in biotopes and shelters in which the microclimate is more humid than the environment.

It is concluded that there is a connection between the relative dimensions of the spiracles of sandflies and the humidity of the regions in which they occur and that the spiracle index can be taken as an indicator of their resistance to dryness.

[Gnedina (M. P.).] **Гнедина (М. П.). Contribution to the Biology of the Nematode *Onchocerca gutturosa* Neumann, 1910, parasitising Cattle.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **70** no. 1 pp. 169–171, 3 figs., 1 ref. Moscow, 1950.

Adults of *Simulium ornatum* Mg. were reared from pupae taken in a river in the Province of Moscow and allowed to feed for 3–5 minutes on cattle known to harbour *Onchocerca gutturosa*. Of 104 that were subsequently dissected, 26·3 per cent. contained larvae of the Nematode, the number in individual flies ranging from 1 to 507. Their development was traced and five larval stages were distinguished. These are described and their situations in the fly indicated. They occurred 2, 6, 12, 21 and 35 days after feeding, respectively. Steward found infective stages in the head of the flies on 19th–22nd day [*R.A.E.*, B **25** 227], but in the author's investigations larvae were present in the thoracic muscles on the 35th day, and none was found in the head. This may indicate that development depends on temperature, as the Simuliids were kept at laboratory temperatures of 16–18°C. [60·8–64·4°F.].

Metcalf (C. L.) & Flint (W. P.). **Destructive and Useful Insects. Their Habits and Control.**—3rd edn. revd. by R. L. Metcalf, 9¼×6¼ ins., xiv+1071 pp., 584 figs., many refs. New York & London, McGraw-Hill Book Co., Inc., 1951. Price 85*s*.

This third edition of a text-book of economic entomology in the United States and southern Canada resembles the previous ones [*R.A.E.*, B **17** 19; **27** 262] in general arrangement, but, in order to bring it up to date, some sections, notably those dealing with insecticides and other materials used in chemical control and with equipment for the application of insecticides, have been extended and partly rewritten. The structural formulae of over 150 substances and information on their chemical, physical and insecticidal properties are given. The recommendations for the control of specific pests contained in the latter part of the book have been modified accordingly, and a number of additional Arthropods that have recently become injurious are included.

Mattingly (P. F.). **Anopheline Pupae (Diptera, Culicidae) from West Africa.**—*Ann. trop. Med. Parasit.* **43** no. 1 pp. 23–25, 2 figs., 4 refs. Liverpool, 1949.

The pupa of *Anopheles flavicosta* Edw. is described for the first time from a single pelt with associated larval pelt and adult from Makurdi, Southern Nigeria, and the relevant part of De Meillon's key [*R.A.E.*, B **36** 59] is amended to include it.

An Anopheline pupal pelt from Bawku, Gold Coast, believed to be one of those described by Ingram & Macfie as *A. rufipes* (Gough) [**8** 12] was found to agree with their description and figure but to differ from the pupa of *rufipes* in important particulars. Examination of the pupa of *A. rufipes* var. *ingrami* Edw. from Sierra Leone referred to in Evans' monograph [**26** 182] and of nine pelts with associated adults of this variety from Kabba, Southern Nigeria, details of which are given, showed them to agree in all essential respects with pupae of typical *rufipes*, of which there is little reason to suppose that var. *ingrami* is more than a colour form. It is suggested that the pupae described by Ingram & Macfie were those of *A. theileri* var. *brohieri* Edw. [**18** 43], as this is the only remaining West African Anopheline with an undescribed pupa and is restricted to a small area of the Gold Coast, including the locality where Ingram & Macfie's pupae were found. The adult differs from that of *ingrami* in small points only. The resemblance of the pupa to that of *A. funestus* Giles suggests that *brohieri* should be considered a distinct species intermediate between *A. theileri* Edw. and *A. funestus*. Whether this is so can only be decided when properly associated early stages of *brohieri* have been found.

Koch (W.) & Kaplan (D.). **Air Movement under Mosquito- and Sandfly-nettings.**—*Ann. trop. Med. Parasit.* **43** no. 1 pp. 26–31, 1 pl., 2 graphs, 6 refs. Liverpool, 1949.

The following is virtually the authors' summary. The reduction of air movement caused by full-sized textile fabric insect-nettings was tested with five samples of netting. It is recommended that the square root of x/y, where x is the air speed after passing through the netting and y is the free air speed without the netting, should be the formula used as a measure of the reduction of air movement. In nettings fine enough to exclude sandflies [*Phlebotomus*], free space is not related to permeability. This is demonstrated by army sandfly-netting 1, which, though it has the largest free area, as determined by two different methods, shows the lowest permeability to air when tested by the recommended formula.

Carter (H. F.) & Antonipulle (P.). **Observations on Sandflies (*Phlebotomus*) in Delft Island, North Ceylon.**—*Ann. trop. Med. Parasit.* **43** no. 1 pp. 62–73, 2 figs., 1 map, 6 refs. Liverpool, 1949.

The following is substantially the authors' summary. Observations on sandflies (*Phlebotomus*) on Delft Island, North Ceylon, were made in July and August 1947 and in January 1948, during the dry season and at the end of the wet season. They were prevalent in the houses during both periods, but were more abundant after the rains in January. They were less prevalent in inhabited areas of the west than in those of the east and centre, where in January the average number caught per house by spray-catching was over 20. Catches in individual houses showed considerable variation during both periods ; the highest catch from a single house (one room) was 104. Captures by spray-catching were greater than by hand-catching for the same type of house, the

differences being least in houses with whitewashed interiors, where the sandflies were more easily seen for hand-catching. The prevalence of sandflies in human-baited traps set in the evenings in verandahs varied considerably on different days, but in general was similar during both observation periods. Light-traps were not found satisfactory. Oiled-paper traps, set overnight near holes and cracks in the floors and low down in the walls of houses, yielded many sandflies, but others set near similar places in the open were not successful.

Over 4,000 of the sandflies collected were identified. *P. argentipes* Annan. & Brun. was overwhelmingly predominant in all localities and formed nearly 98 per cent. of the total catch. *P. antennatus* Newst., not previously recorded from Ceylon, and at least two other species, one of which may be *P. babu* Annan., were found in small numbers. *P. zeylandicus* Annan., a species common on the mainland, was not found. About 21 per cent. of all the examples of *P. argentipes* were males, but the proportion varied in different collections. The proportions found in collections from houses by spray-catching (21–23·4 per cent.) were 2–3 times as great as those obtained by hand-catching. In oiled-paper and animal-baited traps, the proportions of males were very high (68 and 75·5 per cent.). Not less than 49 per cent. of the females were engorged, and 2·7–7·1 per cent. had ripe ovaries in July and August, and 6·2–18·3 per cent. in January.

Materials collected from 148 possible breeding places were examined by the flotation method, and immature stages were found in 19 of them. The breeding places discovered were the floors and plinths of houses (14), soil at the edges of heaps of refuse (3) and soil at the bases of stone walls (2). Breeding appears to be restricted during the dry season, since one only of the 38 sites examined in July and August was found positive, a single pupal case being present in material from the plinth of a house. The remaining breeding places were found in January (18 in 110 sites examined) when larvae, larval skins and pupal cases were present. In a single experiment in the laboratory, adults of *P. argentipes* were reared from eggs laid by captive females. The period of development was 27–35 days.

Smithburn (K. C.), Haddow (A. J.) & Lumsden (W. H. R.). **An Outbreak of sylvan Yellow Fever in Uganda with *Aëdes* (*Stegomyia*) *africanus* Theobald as principal Vector and Insect Host of the Virus.**—*Ann. trop. Med. Parasit.* **43** no. 1 pp. 74–89, 1 map, 12 refs. Liverpool, 1949.

Observations in Uganda have indicated that yellow fever can persist in the forest in the absence of man and that *Aëdes africanus* (Theo.) is a likely vector [*cf. R.A.E.*, B **39** 132]. In order to locate a forest focus of virus activity in which intensive epidemiological investigations to confirm this might be carried out, surveys using sentinel rhesus monkeys (*Macaca mulatta*) were begun in Bwamba county in August 1945 and continued and expanded in the following years. No positive results were obtained there in 1945–47 when the monkeys were confined in cages in the forest canopy, but after it was found that *A. africanus* will not enter a cage to bite [*loc. cit.*] uncaged monkeys were kept on leashes on platforms in the forest canopy from February 1948. Eight monkeys at four stations became infected between early May and the end of October and four of them died. No infection occurred in the same period at 20 other posts, including eight that were near the four where the positive results were obtained.

Intensive catching of biting insects in the affected area with human bait and New Jersey traps [**31** 195, etc.] was begun as soon as the appearance of immunity in a sentinel monkey was confirmed and continued until early

October. The insects caught were used in groups to inoculate rhesus monkeys. Four out of six monkeys inoculated with suspensions of *A. africanus* acquired yellow fever, as did another on which some of the newly collected females of this mosquito were fed. The virus was also isolated from a monkey that had been inoculated with suspensions of *Phlebotomus* spp., but only after an uncommonly though not impossibly long incubation period. Further studies are needed to determine whether species of *Phlebotomus* can play a part in the epidemiology of yellow fever. Inoculation of suspensions of mosquitos of the subgenera *Coquillettidia* and *Mansonioides* of *Mansonia* (*Taeniorhynchus*), *Aëdes simpsoni* (Theo.), arboreal *Aëdes* other than *A. simpsoni* and *A. africanus*, *Chrysops centurionis* Aust., *Simulium* spp. and Ceratopogonids gave negative results.

Fairbairn (H.) & Culwick (A. T.). **The Differentiation of the polymorphic Trypanosomes.**—*Ann. trop. Med. Parasit.* **43** no. 1 pp. 90–95, 15 refs. Liverpool, 1949.

An account is given of studies on the separation of the polymorphic trypanosomes [*cf. R.A.E.*, B **37** 196, etc.] by morphometrical examination of the blood and metacyclic forms. The latter were obtained by Burtt's method [**37** 137] modified by omission of the coating on the slides. Though the mean lengths of the metacyclic forms varied from day to day, even in the same fly, neither the species of *Glossina* nor the host from which it was infected had any significant effect. Similarly, the mammalian host did not influence the measurements of blood forms. On the basis of the measurements of the blood forms, the trypanosomes could be divided into two distinct groups. The first comprised *Trypanosoma gambiense*, *T. rhodesiense* and one type of *T. brucei*, the length frequencies of all of which tended markedly to normality. The measurements of the metacyclic forms made it possible to differentiate *T. gambiense*, which was much shorter, from the other two. The second blood group consisted of a second type of *T. brucei* in which the mean lengths of the forms fluctuated widely and the length-frequency distribution curves were often abnormal, suggesting a mixture of two or more components, which occur in varying proportions but which have so far defied attempts at separation. The metacyclic trypanosomes of this type were significantly shorter than those of the other type, and approached *T. gambiense* in mean length. It was found that if a rat were simultaneously infected with *T. rhodesiense* and a strain of *T. brucei* of the first type (which are indistinguishable), the resulting strain corresponded in the measurements of both blood and metacyclic forms to the second type of *T. brucei*. It was non-infective to man but was transmissible cyclically by *G. morsitans* Westw.

Papers noticed by Title only.

Lewis (D. J.) & Kirk (R.). **The Zoogeography of the Ethiopian Species of *Phlebotomus* Agassiz (Diptera Psychodidae).**—*Proc. R. ent. Soc. Lond.* (A) **24** pt. 4–6 pp. 51–55, 8 refs. London, 1949.

Lewis (D. J.). **Tracheal Gills in some African Culicine Mosquito Larvae.**—*Proc. R. ent. Soc. Lond.* (A) **24** pt. 4–6 pp. 60–66, 2 figs., 10 refs. London, 1949.

Solomon (M. E.). **Control of Humidity with Potassium Hydroxide, Sulphuric Acid, or other Solutions.**—*Bull. ent. Res.* **42** pt. 3 pp. 543–554, 1 graph, 26 refs. London, 1951. [See *R.A.E.*, A **40** 69.]

DICK (G. W. A.), BEST (A. M.), HADDOW (A. J.) & SMITHBURN (K. C.). **Mengo Encephalomyelitis. A hitherto unknown Virus affecting Man.**—*Lancet* Aug. 21, 1948 pp. 386–389, 3 graphs, 16 refs. London, 1948.

The virus of Mengo encephalomyelitis was first isolated from a captive paralysed rhesus monkey [*Macaca mulatta*] at the Yellow Fever Research Institute in Entebbe, Uganda, and subsequently from a mongoose (*Ichneumia*) and individuals of *Mansonia* (*Taeniorhynchus*) *fuscopennata* (Theo.) from the same compound, from another batch of *Mansonia*, mainly of the same species, and, about a year after the first isolation, from another unused captive rhesus monkey that was febrile but showed no evidence of paralysis. Later, a case of the disease developed in one of the authors (G.W.A.D.) who was living in the compound. Accounts are given of the clinical features of his illness, which included headache, delirium and vomiting and symptoms of paralysis, the isolation of the virus in laboratory animals, and the immunological studies made to identify it. Neutralising antibodies could still be demonstrated in his serum more than a year after the acute stage of the illness which had lasted for about a week. Of 236 other human sera tested, two showed immunity from the virus of Mengo encephalomyelitis. They were those of two children, aged 4 and 6 years, living on the edge of the Budongo Forest in a village in the Western Province of Uganda. It is therefore established that the human infection can be contracted naturally. The immune children had no neurological symptoms.

HARTZELL (A.). **Effectiveness of *N*-(2-ethylhexyl)bicyclo [2.2.1]-5-heptene-2, 3-dicarboximide on Houseflies.**—*Contrib. Boyce Thompson Inst.* **15** no. 7 pp. 337–339, 6 refs. Menasha, Wis., 1949.

N-(2-ethylhexyl)bicyclo[2.2.1]-5-heptene-2,3-dicarboximide is a commercially available insecticide marketed as Van Dyk 264 and formerly designated Octacide 264. Its physical properties and the method of preparing it are given, and experiments on its toxicity to *Musca domestica* L. as a spray in refined oil are described. They were made by the large-group Peet-Grady method [*R.A.E.*, B **37** 5, 89], and the results obtained with various concentrations of the imide alone or combined with pyrethrins and sometimes with DDT or chlordan also are given in a table. The official test insecticide (O.T.I.), which contained approximately 0·1 gm. pyrethrins per 100 ml., was the standard of comparison. The imide at 2 per cent. gave higher kills than the O.T.I., but double this concentration was required for approximately equal knockdown. Knockdown equal to or better than that given by the O.T.I. was obtained when 0·025 per cent. pyrethrins was added to 2 per cent. imide. When 0·2 per cent. DDT was added to 0·8 or 1 per cent. imide and 0·02 or 0·025 per cent. pyrethrins, knockdown corresponding to that given by the O.T.I. and much higher kills were obtained, but the best results (99 per cent. knockdown and 98 per cent. kill) were given by a combination of 0·8 per cent. imide, 0·02 per cent. pyrethrins and 0·2 per cent. chlordan.

MITLIN (N.), NELSON (R. H.) & GERSDORFF (W. A.). **Toxicity to House Flies of Ethyl Analog of TDE and Mixture containing Heptachlor.**—*Soap & sanit. Chem.* **27** no. 11 pp. 139, 143, 2 refs. New York, N. Y., 1951.

An account is given of experiments made by the Campbell turntable method [*R.A.E.*, B **26** 246] to determine the toxicity to house-flies (*Musca domestica* L.) of the ethyl analogue of DDD (TDE), known also as Q-137 [1,1-di(p-ethylphenyl)-2, 2-dichloroethane], and heptachlor 70–30, which is a mixture

containing 70 per cent. heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] and 30 per cent. of an unidentified isomer of chlordan. Pure p,p'DDT and heptachlor of a high degree of purity were also tested for comparison, and pyrethrins to check the susceptibility of the flies. The materials were dissolved in refined kerosene at concentrations to give more and less than 50 per cent. mortality. The concentrations per ml. needed for 50 per cent. mortality, ascertained by plotting on log-probability paper, were 0·184 mg. heptachlor 70–30, 0·093 mg. heptachlor, 1·71 mg. ethyl-DDD, 0·348 mg. DDT and 2·39 mg. pyrethrins. The acute toxicity of ethyl-DDD to mice was stated by the manufacturer to be 6,600 mg. per kg. If its chronic toxicity to mammals is equally low, it should have value for space sprays.

Moore (D.). **Laboratory Studies of Combinations of Piperonyl Cyclonene, Piperonyl Butoxide, Pyrethrins, and Rotenone for the Control of Ticks on Dogs.**—*J. Parasit.* **36** no. 4 pp. 322–325, 4 refs. Lancaster, Pa., 1950.

The results are summarised of tests made in Maryland of emulsions containing piperonyl butoxide in combination with pyrethrins or rotenone or both and dusts containing piperonyl cyclonene with pyrethrins and sometimes rotenone also for the control of adults of *Dermacentor variabilis* (Say) and all stages of *Rhipicephalus sanguineus* (Latr.) on dogs. The emulsions, which were prepared from three concentrates, were used as dips in which infested dogs were completely immersed. Dusts, all of which had pyrophyllite as the base, were applied from a shaker can at 1 oz. to each average-sized dog and worked well into the hair. The results are given in tables. Of the emulsions, the most effective was one containing 0·2 per cent. piperonyl butoxide and 0·01 per cent. pyrethrins, which gave 96 and 100 per cent. mortality of *D. variabilis* in 24 hours in two tests (with no increase in mortality after 96 hours in the first) and 91 per cent. mortality of *R. sanguineus* in 96 hours. In two tests at half this strength, it caused 85 and 97 per cent. mortality of *R. sanguineus* in 96 hours. The other emulsions were tested against *R. sanguineus* only. One containing 0·16 per cent. piperonyl butoxide and 0·04 per cent. rotenone gave 90 per cent. mortality in 72 hours, and 50 per cent. when diluted to half this strength. The remaining formula, which contained both pyrethrins and rotenone was ineffective, giving only 24 per cent. mortality in 24 hours at 0·16 per cent. piperonyl butoxide, 0·004 per cent. pyrethrins and 0·02 per cent. rotenone, the highest concentration tested. The dusts tested against *R. sanguineus* contained 0·625 per cent. piperonyl cyclonene and 0·05 per cent. pyrethrins and half these quantities, and they gave 99 and 89 per cent. mortality, respectively, in 24 hours. The stronger dust caused only 22 per cent. mortality of *D. variabilis*, but one containing 1 per cent. piperonyl cyclonene, 0·1 per cent. pyrethrins and 0·5 per cent. rotenone gave 94 per cent. mortality and the same diluted to half strength gave 50 per cent.

Yeh (J.) & Davis (D. E.). **Seasonal Changes in Abundance of Fleas on Rats at Baltimore, Md.**—*Publ. Hlth Rep.* **65** no. 10 pp. 337–342, 2 graphs, 4 refs. Washington, D.C., 1950.

To determine the seasonal changes in the prevalence of fleas on rats in Baltimore, Maryland, 966 rats (*Rattus norvegicus*) were caught between 7th January 1946 and 3rd March 1947 in warehouses in which poultry were kept for a few days before being slaughtered. For analysis of the data, the period was divided into seven seasons according to temperature and precipitation. These were the hibernal season, which was cold and had considerable precipitation ; the prevernal season, which was warmer and had about the same precipitation ; the vernal season, which was still warmer and had heavy rainfall

in several weeks ; the aestival season, which was hot with considerable rain ; the postaestival season, which was slightly cooler with several very dry weeks, the serotinal season, which was cooler and moderately wet, and the autumnal season, which was short, cool and dry. The percentages of rats infested with *Xenopsylla cheopis* (Roths.) in the first hibernal season, the prevernal, vernal, aestival, postaestival, serotinal and autumnal seasons and the second hibernal season were 17·7, 2·1, 12·7, 55·7, 25·6, 36·8, 64·7 and 29·5. The corresponding percentages for *Nosopsyllus fasciatus* (Bosc) were 50·8, 57·2, 59·3, 27·7, 5·2, 11·2, 31·3 and 43·1 and for *Leptopsylla segnis* (Schönh.) 4, 10·8, 17·4, 0, 0, 1·8, 0 and 0.

Fox (I.) & Kohler (C. E.). **Distribution and relative Abundance of the Species of Biting Midges or *Culicoides* in eastern Puerto Rico, as shown by Light Traps.**—*P. R. J. publ. Hlth* **25** no. 3 pp. 342–349, 1 map, 15 refs. Burlington, Vt., 1950. (Also in Spanish pp. 350–358.)

Until recently, the only species of *Culicoides* known to occur in Porto Rico were *C. furens* (Poey) and *C. phlebotomus* (Will.), which early attracted attention because of their bites. Since 1944, seven more species have been recorded there ; three were discovered in special habitats such as tree holes, and the occurrence of the other four was revealed by light-trap collections. The distribution and abundance of the species in Porto Rico is discussed, mainly from data obtained from catches in light-traps maintained in connection with work on Anopheline control.

Perry (A. S.) & Hoskins (W. M.). **Synergistic Action with DDT toward resistant House Flies.**—*J. econ. Ent.* **44** no. 6 pp. 839–850, 9 figs., 29 refs. Menasha, Wis., 1951.

The investigations here recorded, made in California between March 1949 and June 1950, had the object of finding a synergist that would make DDT effective against strains of house-flies (*Musca domestica* L.) that are resistant to it. Acetone solutions of p,p′ DDT alone and combined with possible synergists were applied topically to the thorax of flies, and other flies were exposed to settling mists of kerosene solutions for five minutes. The topical dosages of DDT required for 50 per cent. mortality of flies of four strains of different susceptibility (the Berkeley, Laton, Super Laton and Bellflower strains) were 0·054, 0·5, 2·5 and 7·4 mmg., and the amounts needed to give the same mortality of the first three in spray tests (calculated from concentrations and the deposit of coloured spray on certain flies) were 0·093, 0·7 and 2·41 mmg. The Berkeley and Laton strains were used in preliminary tests of DDT combined with possible synergists applied topically at 0·05 and 0·5 mmg. DDT, respectively, and generally 10 mmg. synergist per fly. Some of the chemicals increased mortality and others decreased it, n-amyl-β-naphthyl ether, the most toxic when used alone, being the only one that markedly increased mortality of both strains. Piperonyl cyclonene largely inhibited the effect of DDT on the susceptible Berkeley strain but so increased its effect on the resistant Laton strain that it caused 100 per cent. mortality. Further work was concentrated on this substance, which is referred to below as PC. Tables are given showing the amounts of DDT needed to give 50 per cent. mortality of each of the four strains when combined with various amounts of PC and tested by topical application and the concentrations of DDT needed to give the same mortality of three strains when combined with various concentrations of PC and tested by exposing 50 females to the settling mist from 4 ml. solution in a small spray chamber [*R.A.E.*, B **37** 201]. The optimum amounts of PC enabled the amounts of DDT to be reduced by about 90 per cent. in all tests against the resistant strains and by 4 and 44 per cent. in topical and spray

tests against the Berkeley strain. In preliminary topical tests on the Super Laton strain, the toxicities of DDD (TDE) and methoxy-DDT (methoxychlor) were increased by PC, but not so markedly as that of DDT. The action of PC is shown not to be due to an increase in penetration of the insecticide to the body in its presence, since application of PC and DDT separately to different parts of the body gave the same result, and the larger amounts of PC actually retarded penetration of DDT. With a single doubtful exception, the optimum ratios of DDT to PC increased with the resistance of the strains. There was thus no indication of any stoichiometric relation between them, and in view of the mechanism of action [see next abstract], none is to be expected.

In preliminary tests in which flies were exposed in vials with an interior coating of DDT or DDT and PC, mortality was much increased by the inclusion of the synergist. Piperonyl butoxide and N-(2-ethylhexyl)-bicyclo[2.2.1]-5-heptene-2,3-dicarboximide tested as adjuvants for DDT used as a spray in kerosene solution increased mortality, but not as much as did PC.

PERRY (A. S.) & HOSKINS (W. M.). **Detoxification of DDT as a Factor in the Resistance of House Flies.**—*J. econ. Ent.* **44** no. 6 pp. 850–857, 1 fig., 11 refs. Menasha, Wis., 1951.

Details are given of a degradation of DDT to the relatively harmless DDE [1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene] in four strains of house-flies [*Musca domestica* L.] of different degrees of resistance [see preceding abstract] treated by topical application of DDT in acetone solution. The quantitative relation of the process to the action of PC (piperonyl cyclonene) as a synergist [*loc. cit.*] was also investigated. Dosages that would kill about half the flies without PC were used to allow of examination of both living and dead flies. The total amount of DDT and DDE recovered from outside and inside the flies was never equivalent to the total amount of DDT applied, and, as the loss could not be accounted for in other ways, it is concluded that some absorbed DDT was converted to an unidentified form. Since very little DDT is wiped off when moderate dosages are used, the rates of penetration were estimated from the difference between the amount applied and the amounts found externally after various intervals. Surviving flies of a given strain always contained more DDE and less DDT than those that died, showing that the ability to change absorbed DDT to DDE is a major factor in survival among individuals of a single strain. The large differences in susceptibility between strains were also correlated with this ability. The formation of DDE was strongly inhibited in the presence of PC, so more DDT remained within the body, although less was absorbed, when the chemicals were used together. Their synergism is related to interference with this degradation process. Living flies continued to absorb DDT for at least 120 hours, and probably do so for as long as any remains on the body, but very little was absorbed after death. The rate of entry was high during the first 12–24 hours and decreased thereafter. In each strain, total recovery of DDT and DDE was higher in dead than in surviving flies. It was only slightly affected by the use of PC, which thus seems to have a minor influence on the formation of the unknown derivative. The unknown process appears to continue as long as the flies live, but DDE did not increase in any of the three resistant strains after the first analysis at 12 or 24 hours.

In many cases, small amounts of DDE were found in the rinsings used to remove unabsorbed DDT. If the chief site of dehydrohalogenation is the cuticle [*cf. R.A.E.*, B **39** 211], some of the newly formed DDE may diffuse outwards far enough to be removed by the solvent. Resistant strains can retain relatively large amounts of DDT in the body without showing injury. The maximum amounts are reached in less than 12 hours.

The three defence mechanisms in the house-fly against injury from DDT are summarised as detoxification to DDE, detoxification to one or more unidentified derivatives, and storage of unchanged DDT in regions where it has no appreciably harmful effects. The first appears to be most interfered with by PC. All three processes occur in all strains of flies examined so far. The question of the mechanism of origin of resistant strains is closely related to that of the existence of a means of resistance throughout the species. If the necessary biochemical system is present to some degree in all house-flies, resistant strains may arise by breeding of those in which it is more highly developed.

It is tentatively concluded that accumulation of DDT within the body is generally associated with fatal results, but no numerical relationship exists. The very great increase in mortality caused by the addition of PC to DDT is accompanied by marked lowering of the DDE formed. In the absence of the synergist, resistance to DDT is correlated with formation of DDE during the first 12–24 hours ; afterwards this substance remains relatively constant for several days.

FULLMER (O. H.) & HOSKINS (W. M.). **Effects of DDT upon the Respiration of susceptible and resistant House Flies.**—*J. econ. Ent.* **44** no. 6 pp. 858–870, 12 figs., 14 refs. Menasha, Wis., 1951.

As it has been found that DDT increases the respiration of treated insects [*R.A.E.*, A **37** 188, 486] over a very wide range of dosages, a study was made of the effect of topical application of DDT on respiration of house-flies [*Musca domestica* L.] of the susceptible Berkeley strain and the resistant Super Laton strain [B **40** 55]. The apparatus, materials and methods used are described. Flies were kept at 25°C. [77°F.] except where otherwise stated. The strains normally respire at equal rates at this temperature but differed in response to DDT. Application of 0·05–50 mmg. DDT to susceptible flies caused the rate of respiration to increase after periods varying from about four hours with small doses to a few minutes with very large doses, and successively higher maximum rates were reached in progressively shorter periods as dosage increased. Greatest effect in magnitude and speed of onset (about a fourfold increase after one hour) was produced by 50 mmg. After reaching the maximum, the rate declined more or less in proportion to its previous rise. The increase in the rate of respiration of resistant flies caused by DDT was much less than that of susceptible flies and rather irregular, whereas both strains respired at about the same high rate when treated with 1,1-bis-parachlorophenyl-2-nitropropane.

When PC (piperonyl cyclonene) was mixed with the DDT applied to resistant flies, the respiration curves became progressively more like those of the susceptible flies as the quantity of PC increased, but the maxima reached were never so high and were attained later. Up to a certain concentration of PC, increases in the amount reduced the time needed for the greatest respiration rate to be attained, but further increases delayed the reaching of the maximum and eventually reduced the level reached. Thus, a second factor was operating in addition to the interference with breakdown of DDT [see preceding abstract]. Large amounts of PC also delayed and reduced the respiration peak in susceptible flies. When the DDT and PC were applied separately to different parts of the body, the respiration maxima were as high as when both were applied together and occurred somewhat earlier. When PC was applied 0–28 hours before DDT, their effect on respiration decreased as the interval increased. With a dosage of 5 mmg. DDT per fly, the maximum effect of PC on respiration of resistant flies was obtained with 25 mmg. applied at the same time as the DDT but separately from it. The respiration response of susceptible

flies to DDT was also increased when PC was applied separately but simultaneously, which indicates that some of the DDT is detoxified in flies of all strains when it is used alone and supports the mortality data and analyses [see two preceding abstracts].

All groups treated with completely lethal amounts of DDT, with or without PC, ceased to respire after 16–24 hours. Doses causing 50 per cent. mortality caused a comparatively small increase after 3–4 hours, and respiration continued at a slowly declining rate for 36–48 hours. There was general coincidence of onset and degree of accelerated respiration and hyperactivity. Doubtless these are related as cause (hyperactivity) and effect (accelerated respiration). Rates of respiration are shown in relation to absorbed DDT. The ratio of the respiration rates of resistant flies to those of susceptible ones showed that according to this criterion, 60–75 per cent. of resistance could be removed by the use of PC.

There was a marked difference between the respiration of the susceptible and resistant strains at 35°C. [95°F.] when no DDT was applied. The respiration of each was higher than at 25°C. but the rate remained practically constant for about three hours in the resistant flies whereas it decreased rapidly in the susceptible ones, showing that the former are much more resistant to the stress of high temperature. Resistance to DDT at lower temperatures is also associated with ability to remain active longer. At 35°C., the respiration of the resistant flies after treatment with DDT plus PC was below that of the susceptible strain, just as at 25°C. Whereas 0·25 mmg. DDT and 25 mmg. PC caused a considerable increase in respiration of resistant flies at 25°C., 0·5 mmg. DDT with 25 mmg. PC had no appreciable effect at 35°. The total respiration from time of treatment till death is the same at 25°C. for the two strains but is considerably lower than that of untreated flies. At 35°C., total respiration is the same for treated and untreated flies of both strains, and DDT appears to have less influence than environment in causing death. Evidence is given that individual flies that respond early to exposure to DDT and show great activity die early, whereas those that respond slowly and less fully survive longer.

Dicke (R. J.) & Paul (J. J.). **Space Spray Combinations of chlorinated Insecticides.**—*J. econ. Ent.* **44** no. 6 pp. 896–898, 1 fig., 4 refs. Menasha, Wis., 1951.

The synergistic effect of other chlorinated-hydrocarbon insecticides with DDT in space sprays against house-flies [*Musca domestica* L.] was tested in the laboratory on the basis of comparison of the mortalities given by the mixtures with the sum of the mortalities given by the components tested separately at their respective concentrations. All the materials were used as kerosene solutions. The following is based on the authors' summary of the results. DDT and chlordan showed synergism throughout the range of combinations tested (9 : 1–1 : 9), and a somewhat lower level of synergism was obtained with DDT and benzene hexachloride (95 per cent. γ isomer). Synergism for mixtures of DDT with toxaphene (technical) or aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,-5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] was evident only when the concentration of DDT was lower than that of the other insecticide. Antagonism was indicated where the concentration of DDT in a mixture was appreciably in excess of aldrin or dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene]. Relatively little or no synergism was demonstrated in combinations of DDT with dieldrin.

ROGOFF (W. M.) & METCALF (R. L.). **Some insecticidal Properties of Heptachlor.** —*J. econ. Ent.* **44** no. 6 pp. 910–918, 26 refs. Menasha, Wis., 1951.

The experiments described in this paper, which is noticed in more detail elsewhere [*R.A.E.*, A **40** 106], included some against flies and cockroaches. Heptachlor (1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene) was equivalent to aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro - 1,4,5,8 - diendomethanonaphthalene] and dieldrin [1,2,3,4,10, 10 - hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendo - methanonaphthalene] in toxicity to females of *Musca domestica* L., but less toxic to them than γ benzene hexachloride or parathion, and it was more toxic than either chlordan or DDT to *Lucilia* (*Phaenicia*) *sericata* (Mg.) and *Blattella germanica* (L.).

GERSDORFF (W. A.), NELSON (R. H.) & MITLIN (N.). **The relative Effect of several Pyrethrum Synergists in Fly Sprays containing Allethrin.**—*J. econ. Ent.* **44** no. 6 pp. 921–927, 7 refs. Menasha, Wis., 1951.

The effects of three synergists for pyrethrum in sprays containing either allethrin [the synthetic allyl homologue of cinerin I] of 94 per cent. purity or pyrethrins (54 per cent. pyrethrin I and cinerin I) were compared in tests against *Musca domestica* L. by the turntable method [*R.A.E.*, B **26** 246]. The synergists were piperonyl butoxide, n-propyl isome and synergist 264 (N-octyl bicycloheptene dicarboximide [presumably N-(2-ethylhexyl)-bicyclo[2.2.1]-5-heptene-2,3-dicarboximide (*cf.* **40** 56)], all of technical grade. After the preliminary tests in which proportions varied, the adjuvants and main toxicants were used in the ratio of 10 : 1. Knockdown and mortality results are summarised in a table. Allethrin caused slightly slower knockdown than did natural pyrethrins. However, all sprays caused complete or nearly complete knockdown in 25 minutes at 0·25 mg. insecticide per ml. kerosene. The joint action of each of the three adjuncts with each insecticide was synergistic. The toxicity of the synergists alone was so low that, at the concentrations used in the mixed sprays, they would be almost non-toxic in themselves.

On the criterion of insecticide equivalent, piperonyl butoxide increased the toxicity of pyrethrins about 13 times and that of allethrin about 2·5 times, but because of the greater toxicity of allethrin [**39** 25], the mixed sprays containing it were nearly half as toxic as those containing natural pyrethrins. The synergistic effect of n-propyl isome was about three times as great with pyrethrins as with allethrin, and both mixtures were about as toxic as allethrin and piperonyl butoxide and less than half as toxic as pyrethrins and piperonyl butoxide. Synergist 264 was less effective ; it increased the toxicity of pyrethrins by two-thirds and that of allethrin by one-third, so that the mixture containing allethrin was about twice as toxic as the one containing pyrethrins.

HOFFMAN (R. A.) & LINDQUIST (A. W.). **Control of the Sheep Tick with low-pressure Sprays.**—*J. econ. Ent.* **44** no. 6 pp. 928–930, 1 ref. Menasha, Wis., 1951.

The effectiveness of insecticide sprays applied at low pressure (about 60 lb. per sq. in.) for the control of *Melophagus ovinus* (L.) on farm flocks of sheep has been under investigation near Corvallis, Oregon. Practical control on long-fleeced sheep crowded into small enclosures and sprayed thoroughly under the throat, around the crotch and on the back and sides was obtained with DDT, chlordan, toxaphene and methoxy-DDT (methoxychlor) at 0·5 per cent. and with benzene hexachloride at 0·025 per cent. γ isomer. Chlordan

gave the most consistent results, control on lambs and ewes still being 99 and 100 per cent., respectively, after 55–120 days. Pyrethrins with piperonyl butoxide (0·01 and 0·1 per cent., respectively) and rotenone (0·0075 per cent.) both gave good initial results, but not satisfactory long-term control. When recently shorn ewes and short-woolled lambs were sprayed, nearly complete control was obtained for six months with 0·25 or 0·5 per cent. methoxy-DDT or 0·5 per cent. toxaphene as emulsified solutions and with wettable-powder suspensions containing 0·5 per cent. DDT, methoxy-DDT, chlordan or toxaphene. A suspension containing 0·025 per cent. rotenone gave only 62 per cent. control after 4–6 months. Comparative tests of sprays applied at high-pressure (up to 350 lb. per sq. in.) [*cf. R.A.E.*, B **38** 94] and at low pressure showed no difference in control on medium-fleeced lambs after 99 days, but the high-pressure technique was slightly superior on long-fleeced ewes. Wetting agents improved the effectiveness of wettable-powder sprays applied at low pressure. Inconsistent and generally unsatisfactory results were obtained with rectangular, metal-pipe hoops from which DDT, toxaphene or methoxy-DDT at 0·5 per cent. was discharged on to sheep that were forced to pass through them.

Lindquist (A. W.), Roth (A. R.), Hoffman (R. A.) & Butts (J. S.). **The Distribution of radioactive DDT in House Flies.**—*J. econ. Ent.* **44** no. 6 pp. 931–934, 5 refs. Menasha, Wis., 1951.

The following is largely based on the authors' summary of this account of studies on the distribution of radioactive DDT or its metabolites in various internal organs and external parts of DDT-resistant house-flies (*Musca domestica* L.). In individuals topically treated with 8–11·25 mmg. DDT per fly and examined after 24 hours, about 1 mmg. was absorbed and of this some 30 per cent. was in the internal organs and the remainder was distributed throughout the cuticle-hypoderm and head. Flies exposed to a deposit of 5 mg. of the DDT per sq. ft. showed a similar distribution of the DDT or metabolites, but only 0·251 mmg. per fly was absorbed when the proboscis was intact and 0·3 mmg. when it was cut off. As the mortalities from topical treatment and exposure to deposits were similar, it appears that site of entry influences the amount necessary to kill. The prevention of ingestion of the DDT by removal of the proboscis did not appreciably alter the percentage recovery in the different parts. In a series of tests of topical treatments in which the body fluids were separated, it was found that 13 per cent. (0·109 mmg.) of the total absorbed DDT (0·856 mmg.) was in them. The intestinal tract, thoracic ganglion, reproductive system and thoracic muscles of all flies examined showed some radioactivity. When flies were not examined until 60 hours after treatment (although they were all dead after 24 hours), they contained 1·817 mmg. DDT or metabolites. The distribution remained similar.

Dicke (R. J.) & Morgan (B. B.). **Insecticide Dusts for Control of the Brown Dog Tick.**—*J. econ. Ent.* **44** no. 6 p. 991, 2 refs. Menasha, Wis., 1951.

Dogs infested with *Rhipicephalus sanguineus* (Latr.) in Wisconsin were treated with dusts containing 2 per cent. chlordan, 1 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT or 5 per cent. lime-activated sabadilla at an average rate of 0·25 oz. dust per animal. The pens were not treated. The results varied on individual dogs, but BHC and chlordan reduced or eliminated infestations and appeared to retain their effect for an observation period of 24 days, whereas DDT and sabadilla were practically ineffective. When dogs and pens were dusted with 2 per cent. chlordan or 1 per cent. γ BHC,

average infestations of 1, 4 and 5 ticks per dog had been eliminated six months after treatment. No symptoms of toxic action by the insecticides were observed in any of the dogs [*cf.* *R.A.E.*, B **37** 170].

Fales (J. H.), Bodenstein (O. F.), Nelson (R. H.) & Fulton (R. A.). **Effect of Storage on Allethrin Formulations.**—*J. econ. Ent.* **44** no. 6 pp. 991–992, 3 refs. Menasha, Wis., 1951.

Low-pressure and high-pressure liquefied-gas aerosols and a kerosene spray, all containing pure (distilled-grade) allethrin, were tested against *Musca domestica* L. in a Peet-Grady chamber 10, 15 and 6 months, respectively, after the solutions had been prepared. The spray was kept in a darkened cabinet and the aerosol solutions in containers on a laboratory bench, all at room temperature. They were found to have lost none of their toxicity or speed of action as compared with a spray and aerosols freshly prepared from allethrin of the same age. In addition to the propellents [*R.A.E.*, B **39** 134] and kerosene, the aerosol solutions contained 6 per cent. methylated naphthalenes or methylene chloride.

Coher (E. I.) & Shaw (F. R.). **The Distribution of** *Dermacentor variabilis*.—*J. econ. Ent.* **44** no. 6 p. 998. Menasha, Wis., 1951.

During recent years, *Dermacentor variabilis* (Say) has spread northwards and westwards in Massachusetts from its former centres on the Cape Cod peninsula, and the new centres of infestation are expanding and increasing in number. Records are given of collections made in western Massachusetts, which did not appear to concern introduced ticks. Work in 1949–50 showed *Microtus* to be the principal small rodent host and perhaps the principal host. These rodents are extremely numerous on Cape Cod, and the tick populations become very high indeed in some areas.

Yates (W. W.). **Ammonium Carbonate to attract House Flies.**—*J. econ. Ent.* **44** no. 6 pp. 1004–1006, 3 refs. Menasha, Wis., 1951.

The following is the author's summary. Laboratory investigations on the attractiveness of ammonium carbonate to house-flies (*Musca domestica* L.) have shown that the addition of 20 per cent. of this material to bran or other protein feeds provides more attractive bait to females than to males. Such baits were also more attractive to flies over five days old than to flies under that age. Wet mixtures made by adding water were more attractive than dry mixtures, and wet mixtures that had decomposed were even more attractive. The addition of ammonium carbonate to most baits improved their attractiveness.

An inverted cone trap containing ammonium carbonate bait gave proportionally higher catches of older flies than of young flies as compared with the conventional upright trap. It also captured more females. Ammonium carbonate gives up its ammonia very slowly at temperatures below 80°F. but above this point decomposition is fairly rapid. Laboratory tests show that ammonium sulphate plus hydrated lime and water can be substituted for the ammonium carbonate, but it loses its ammonia more rapidly. Ground oats, lucerne meal, or other protein feeds may be substituted for the bran as a carrier.

Fisk (F. W.). **Use of a specific Mite Control in Roach and Mouse Cultures.**—*J. econ. Ent.* **44** no. 6 p. 1016. Menasha, Wis., 1951.

During 1949, mites of undetermined species infesting a large culture of *Periplaneta americana* (L.) were apparently eliminated within a month by the

use of p-chlorophenyl p-chlorobenzenesulphonate as a 5 per cent. spray and a 5 per cent. dust prepared from a 50 per cent. wettable powder. The outsides of the cans and jars containing the cultures and the tables on which they stood were sprayed and the insides, including the cockroaches, were dusted. Only one treatment was needed. In 1951, a small group of white mice was found to be severely infested by *Liponyssus bacoti* (Hirst). The mice were dusted lightly twice in one week with the 5 per cent. dust, and then, as they were still infested, heavier applications of a 10 per cent. dust were made twice weekly during the next fortnight, and the cages were dipped in lysol and dusted with the 10 per cent. dust. Within a month of the initial treatment, the mice were apparently free of mites, and no toxic symptoms were noted in them at any time.

WHITEHEAD (F. E.). **Host Preference of** *Psorophora confinnis* **and** *P. discolor*.—*J. econ. Ent* **44** no. 6 p. 1019, 6 refs. Menasha, Wis., 1951.

The blood in 479 females of *Psorophora confinnis* (Lynch Arrib.) and 783 of *P. discolor* (Coq.) taken in a farmyard in Arkansas in which cattle, horses, mules, pigs and fowls were kept overnight was identified. The percentages that had fed on human, equine, bovine, avian and suine blood were 0·8, 13·5, 68·7, 0 and 16·4 for *P. confinnis* and 0·9, 18·2, 72·6, 0·4 and 7·8 for *P. discolor*. The low proportion that had fed on man may have been due to the effective screening of dwellings.

COLE (M. M.) & LLOYD (G. W.). **Field Tests of selected Repellents against the American Dog Tick.**—*J. econ. Ent.* **44** no. 6 pp. 1025–1026, 4 refs. Menasha, Wis., 1951.

Field tests against *Dermacentor variabilis* (Say) were carried out during June 1951 in well-infested areas on Long Island, New York, with herringbone twill trousers impregnated with emulsions of N-butylacetanilide and dibutyl adipate as standards and four mixtures prepared as all-purpose repellents. The standards were used at 2 gm. and the mixtures at 3·2 gm. per sq. ft. The mixtures contained equal weights of each component, and 10 per cent. Tween 80 was added to all test materials as an emulsifier. Exposure continued until at least 25 ticks had been picked up by the control wearing untreated trousers. The percentages by which the numbers picked up were reduced in three tests, 2, 3 and 4 weeks after treatment, generally with three replications each, averaged 99·6 for dibutyl adipate [*cf. R.A.E.*, B **38** 185], 88 for N-butylacetanilide, 96 for mixture M-1960 (2-butyl-2-ethyl-1,3-propanediol as the principal mosquito repellent, benzyl benzoate as a flea repellent and Trombiculid poison and N-butylacetanilide as the tick repellent), 88 for M-2006 (which contained N-propylacetanilide and the first two of the ingredients of M-1960), 97 for M-2040 (N-butyl-4-cyclohexene-1,2-dicarboximide as mosquito repellent, undecylenic acid as tick, flea and mosquito repellent and N-butylacetanilide) and 99 for M-2041 (a mixture of the five ingredients of M-1960 and M-2040). The relatively low effectiveness of N-butylacetanilide against *D. variabilis* and its great effectiveness against *Amblyomma americanum* (L.) [**38** 132, 151-152] indicate that other species of ticks may vary considerably in their response to the same repellents.

MATTINGLY (P. F.) & others. **The** *Culex pipiens* **Complex.**—*Trans. R. ent. Soc. Lond.* **102** pt. 7 pp. 331–382, 5 figs., refs. London, 1951.

The subject of this symposium is the relationship between the mosquito known as *Culex pipiens* L. and others that are closely related to it and possibly

conspecific, notably *C. fatigans* Wied. (for which most American authors have considered *C. quinquefasciatus* Say to be an earlier name) and the form that has been differentiated as *C. molestus* Forsk. [or *C. autogenicus* Roub. (*cf. R.A.E.*, B **27** 54 ; **33** 94 ; **35** 119)]. The symposium comprises an introduction (pp. 331–342, 1 fig.) by P. F. Mattingly, who is the editor, followed by the six papers noticed below. The author of each paper gives the evidence available to him and the conclusions, usually tentative, to which it has led him. The conclusions of one author are not necessarily consistent with those of another.

In the introduction, the distribution of *pipiens*, largely a North Temperate form said to occur also widely in East and South Africa, and that of *fatigans* which is cosmotropical, are shown on a world map. Another member of the complex of which the distribution is given is "*molestus*", known from western and central Europe, the Near East, North Africa and the Sudan, and apparently quite widely distributed in the United States. M. Wolfs has stated that the form of *pipiens* occurring at Costermansville in the Belgian Congo agrees with *molestus* in being autogenous and in readily biting man although it is dark in colour. The Sino-Japanese population includes an intermediate form known as *Culex pipiens* var. *pallens* Coq., and forms intermediate between *pipiens* and *fatigans* have long been known to occur in the United States. It is concluded from the papers noticed below that according to the weight of available evidence, *pipiens* and *fatigans* hybridise in the southern United States, that *fatigans* ought therefore to be treated as a sub-species of *pipiens*, that the hybrids maintain their intermediate character when bred in pure line, and that in the absence of a conventional method of dealing with the nomenclature of hybridising subspecies, the existing name, *C. pipiens* var. *pallens*, should be retained, at least as a temporary expedient, for the Sino-Japanese form, the hybrids of the United States and Mexico, including the forms originally described as *C. comitatus* D. & K. and *C. quinquefasciatus* race *dipseticus* D. & K., respectively, the pale intermediate form from Melbourne, and the dark Australian form, which does not appear to differ from it except in colour and may be no more than a climatype, probably of earlier introduction.

The value of the various morphological and biological characters that have been used in separating the members of the complex is discussed. The criterion of host preference (that *fatigans* and *molestus* bite man readily while *pipiens* does not) is shown to be a complex one, as even *molestus* prefers birds to man if it has the choice [*cf.* **17** 108], while strains of *fatigans* that do not bite man at all are known [**23** 256 ; *cf.* also **24** 216]. The physiological significance of autogeny is likewise very complex. The literature on the subject is reviewed. It appears that stenogamy is not necessarily linked with mammal biting nor eurygamy with ornithophily, and the association of any of these four characters with autogeny also appears to vary. It seems that in some cases, probably including that of the so-called *pipiens* var. *berbericus* Roub. [**35** 119], reputed anautogenous forms are in reality heterozygous populations with suppressed autogeny. In its stenogamy, food preferences and probably also its homodynamy, *molestus* resembles *fatigans* rather than *pipiens*. Caution is urged in evaluating the significance of size of egg raft and tolerance for foul water [**27** 55] as biological characters. With respect to genetical compatibility, even the form "*molestus*" is shown to be exceedingly heterogeneous. Colour characters are unreliable. The structure of the male palps is shown to be worthless, and the range of variation with respect to the larval siphon recorded by Lewis [**34** 188] for *molestus* in the Sudan overlaps that given for *pipiens* (*s. str.*) in Marshall's monograph [**26** 229]. Agreement is expressed with Laven's conclusion that the *pipiens-molestus* complex involves an assemblage of diverse genetical potentialities, the expression of which is conditioned by the selective action of the environment rather than by any limitation to cross-breeding. However, his corollary

that the idea of *molestus* as an urban biotype is wholly untenable is not accepted. It is thought that in the northern part of the range, the urban environment favours the appearance of a certain combination of characters (autogeny, man-biting, stenogamy, the cryptozoic habit), which are adaptive to this environment. With them are associated certain morphological characters. The result is a fairly well-defined urban biotype and, if it is of assistance to applied entomologists to give this biotype a separate name, it might be called "form *molestus*". Such a name will not imply constancy of physiological, ethological or morphological characters outside the particular ecological niche concerned, and the name should be strictly reserved for urban forms.

Rozeboom (L. E.). **The *Culex pipiens* Complex in North America** (pp. 343–353, 2 figs.). There are four possible populations of the complex in North America. These are typical *pipiens* in the north, the mosquito known in the Old World as *fatigans*, but here called *quinquefasciatus* to emphasise the fact that only the American form is being discussed, in the south [*cf.* **32** 194], the autogenous *pipiens molestus* [*cf.* **18** 1 ; **30** 26], which is apparently widely distributed from New York and Baltimore to California and of which at least one strain is not attracted to man as a host, and an intermediate population in California and Mexico. Dyar & Knab originally described Californian specimens of this intermediate type as *C. comitatus*, but later expressed the opinion that *comitatus* was *pipiens* independently introduced, while Freeborn [**14** 114] stated that he thought it to be identical with the Japanese *pipiens pallens*.

The work in the author's laboratory has failed to reveal a distinct difference between *pipiens* and *quinquefasciatus* with respect to temperature responses [**40** 67], immunity (serological) reactions or susceptibility to infection with *Filaria* (*Dirofilaria*) *immitis*. These two forms are completely interfertile in the laboratory, and 11 generations of hybrids so far obtained have been as vigorous as were the parent stocks. The males do not appear to distinguish between the two kinds of females. Males of typical northern *pipiens* can be separated from those of typical southern *quinquefasciatus* by the relative positions of the arms of the mesosome. In the experimental hybrids, the position of the dorsal arms is in general intermediate between those seen in *pipiens* and in *fatigans*. Back-crossing with a parent strain appeared to result in a shifting of the position of the dorsal arms towards that of the parent. Hybrids can maintain themselves as independent populations. If it could be shown that in the areas where *pipiens* or *molestus* and *quinquefasciatus* exist side by side, they remain distinct from one another, they would have to be regarded as species in spite of the readiness with which they hybridise in the laboratory. If, on the other hand, they intermingle freely and produce a hybrid population, they should be considered to be subspecies. There is evidence that this is what has occurred in southern California and western Mexico ; but it is also possible that an existing hybrid could be introduced into an area and establish a widespread hybrid population. The presence of intermediates in scattered localities in the south-eastern States, indistinguishable from the laboratory hybrids, suggests that hybridisation may be occurring there also. If further work shows an extensive hybrid population in the south-eastern States, the American *pipiens* and *quinquefasciatus* should be considered subspecies. The relationship of *molestus* in the United States to the other populations of the complex is as yet undetermined, although in California, it has been shown to interbreed readily with *quinquefasciatus*. Though Richards observed many differences between his autogenous specimens and the European *molestus* [**30** 26–27], the adults of a strain bred by the author without blood-meals from a female taken in Baltimore agree well with the morphological characters given for *molestus* by Marshall.

The author considers it likely that the *pipiens-fatigans-molestus* complex represents a cosmopolitan polytypic species. Certain populations have diverged, perhaps through isolation, to the point where they show physiological or slight

morphological differences, but this divergence has not progressed to the point where a genetical barrier has developed. Thus, wherever conditions allow contact between recognisably distinct populations, hybridisation causes the production of intermediate populations.

Knight (K. L.). **A Review of the *Culex pipiens* Complex in the Mediterranean Subregion (Diptera, Culicidae)** (pp. 354–364). This contribution is a review of published information of diagnostic value on the members of the complex occurring in the Mediterranean sub-region of the Palaearctic region, including such information from countries of the European sub-region as is necessary for coherence. Descriptions are given of the adults, eggs and larvae of the forms known as *C. pipiens* and *C. molestus* and notes on their variations, distribution and bionomics, including the mechanism of autogeny, and brief notes on the distinguishing characters of three named varieties of the complex differentiated by Roubaud [**35** 119] and some unnamed morphological varieties, and on hybridisation, the relation of *fatigans* to the complex and the possibility that *C. scotti* Theo., known only in the Seychelles, may be a member of it. It is considered that *fatigans*, *molestus* and the other *pipiens* biotypes described are all conspecific with *pipiens*, but that they differ in degree of difference and evolution, so that they cannot all have equal status as subspecies.

Laven (H.). **Untersuchungen und Deutungen zum *Culex-pipiens*-Komplex** [Studies and Interpretations of the *Culex pipiens* Complex] (pp. 365–368). Autogeny, the ability to develop eggs and oviposit without previously taking a blood-meal, has been proved to occur in mosquitos of three different genera, including *Culex "pipiens"*, and is probably far more widespread than it is known to be. In the species that can reproduce autogenously, the ability to do so can be stimulated by abundant food in the larval stage. The autogenous *Culex* has been found in Germany, Holland, France, England, Italy, Hungary, Greece, Malta, North Africa and Egypt. Blood-meals taken after a female has laid an autogenous batch of eggs enable it to lay several additional batches, and the fact that the females apparently bite man very readily, to the point of becoming a pest, has led to the supposition that the antogenous form is more widely distributed than has been proved. There are records of *Culex* plagues from Scandinavia and Russia [*cf.* **32** 121], which would extend the distribution northwards and eastwards if the autogenous form was proved to be responsible. Most of the records of the autogenous form in the northern part of its range are from towns, where the conditions that it needs are more often found.

Autogenous forms are usually obtained in the laboratory from eggs laid by autogenous females before or after a blood-meal, but autogenous offspring have on occasion been reared from anautogenous females. This indicated the existence of a hereditary disposition for autogeny and anautogeny with the latter dominant. Data so far obtained in crossing experiments indicate that the genes for autogeny and anautogeny are allelomorphs. The crossing of anautogenous females from central Germany with homozygous autogenous males from a laboratory strain proved that some of the females had the tendency for autogeny in a heterozygous state. The existence of heterozygotes in a natural population destroys the conception of specific distinction between the autogenous and anautogenous forms.

These findings contribute to the understanding of the distribution of the autogenous form, which, in the northern part of its range, appears to seek quarters where the winter cold cannot reach it to hinder uninterrupted propagation. In exposed situations, eggs or larvae of the pure form perish in winter, and the tendency to autogeny is preserved only in heterozygous overwintering females. In the southern fringe of the range, autogeny is presumably found in most of the population, either in the homozygous or heterozygous state, because the climatic conditions offer practically no opposition to the survival of the autogenous race. Analysis of the population along a line from North Africa

through central Europe to the northern boundary of the range might lead to the discovery of a cline for autogeny.

The morphological characters by which it has been alleged that the autogenous form can be recognised are reviewed. They are light colour, lack of ventral spots on the abdomen, short palps in the male and short siphon in the larva. The first three are shown not to be reliable. The relatively short siphon seems to be peculiar to the larva of the autogenous form. If it were conceivable that this character was in some way connected with autogeny, either the gene for autogeny would be controlling the method of egg production and the dimension of the siphon or a real, close coupling would exist between closely-linked genes.

Drummond (F. H.). **The *Culex pipiens* Complex in Australia** (pp. 369–371). Until recently, *fatigans* was the only known representative of the *pipiens-fatigans* complex in Australia, where it is widely distributed. In 1942, it was quite rare in breeding places in the grounds of the University of Melbourne, but the genus was represented by two other forms. During subsequent years, *fatigans* became plentiful, and *molestus* and a third form not yet described were also present. The identification of *molestus* was based on biological as well as morphological characters and it appeared to be distributed over the southern part of Victoria. Its apparent restriction to the colder part of the continent suggests that it has been recently introduced. In 1942–43, *fatigans* could easily be separated from *molestus*, the males by the structure of the hypopygium and the females by the venational character, but the position subsequently became complicated by the occurrence of intermediates. The *molestus-fatigans* cross can be obtained with ease in the laboratory and it is to be expected that hybrids would occur in nature, as the immature stages of both occupy the same breeding sites simultaneously in Melbourne. Morphological notes are given on the undescribed form, which differs from *fatigans* and *molestus* by being dark in colour. It is widely distributed in Australia, having been recorded from Victoria, New South Wales, Queensland and Western Australia. Little is known of its biology. The immature stages are sometimes found with those of *molestus* and *fatigans*, but are more abundant in clean water from which the others are absent. The adults enter houses but are not known to attack man. So far, they have failed to breed in the laboratory in conditions that were more suitable for *molestus* and *fatigans*. The structure of the male hypopygium is similar to that of *C. p. pallens* and also of *molestus-fatigans* hybrids. It is suggested that if *pallens* originated as a *molestus-fatigans* hybrid, the Australian form may have arisen as a *pipiens-fatigans* hybrid. Alternatively, two primarily physiological species (*pipiens* and *molestus*) may be undergoing similar morphological changes to produce corresponding races.

Christophers (Sir S. R.). **Note on morphological Characters differentiating *Culex pipiens* L. from *Culex molestus* Forskål and the Status of these Forms** (pp. 372–379, 2 figs.). The author recapitulates the characters given for the differentiation of *pipiens* and *molestus* by Marshall & Staley [**25** 136], describes the differences he has observed in the larva and adult ornamentation, palps and hypopygium of British examples of them and discusses the number of eggs in rafts laid by *pipiens* females and by females of the autogenous form before and after a blood-meal. He believes that the basis of a zoological species is the possession of recognisable morphological features and that, in insects at least, hybridisation with fertile offspring does not necessarily dispose of a specific distinction. In borderline cases, convenience should be the deciding factor. In the case of the two forms dealt with, numerous small morphological distinctions seem to give a clear indication of specific difference. If this is accepted, the profound biological differences between them become explicable. He concludes that a distinct specific name is justifiable and desirable for the autogenous form, and that the name *C. molestus* Forsk. (described from the

Nile Delta) should be adopted for the European species. If the autogenous forms of other areas differ from it morphologically they should be named as distinct species, or, more probably, varieties, according to the nature of the differences.

Shute (P. G.). *Culex molestus* (pp. 380–382). After noting that he has never been able to induce females of *C. pipiens* (the *Culex* mosquitos of which the larvae are common in artificial water containers in England between May and September) to feed on mammals in captivity and that the blood in engorged females that he has collected in nature has always been nucleated, the author records the observation of numerous *Culex* females gorged with mammalian blood in London in 1923, in the absence of commensurate numbers of larvae in neighbouring breeding-grounds. He then refers to the complaints of mosquito bites made by users of underground stations as air-raid shelters in 1940 and the subsequent discovery that *molestus* was breeding under the platforms [**29** 18 ; *cf.* also **4** 131], to the complete lack of *molestus* among the numerous *Culex* larvae regularly found in water stored above ground in large tanks for fire-fighting and to the discovery that adults of *molestus* found in bedrooms at Wembley in 1949, where they were constituting a nuisance, were breeding in a water-logged basement. Of adults of the Wembley strain, which has been maintained in the laboratory, about 80 per cent. lay an autogenous batch of eggs, usually 3–4 days after emerging. The percentage laying autogenous eggs and the number of eggs in the batch depends on the larval diet. No female has laid more than one batch of eggs without a blood-meal, but three batches have been laid on a few occasions by females that had a blood-meal after each oviposition. The females will feed on rabbit but not so readily as on man. Glucose seemed to inhibit egg development and oviposition. Mating takes place in a small test-tube. The author considers that the *molestus* nuisance in London is serious and increasing and that *pipiens*, as he knows it, does not feed on mammals. If this is true, the clear definition of *pipiens* is very important. Instances are cited of specific distinctions in other mosquitos being recognised as a result of differences in bionomics. If, as present inquiries indicate, *molestus* adults are unable to develop an adipose body and so cannot pass the winter in a fertilised state, the biological differences between it and *pipiens* are such as to confirm that they are distinct species.

Farid (M. A.). **Relationships between certain Populations of** *Culex pipiens* **Linnaeus and** *Culex quinquefasciatus* **Say in the United States.**— *Amer. J. Hyg.* **49** no. 1 pp. 83–100, 2 graphs, 10 refs. Lancaster, Pa., 1949.

The following is substantially the author's summary of this paper, which is concerned with mosquitos that represent four geographically separated populations of the complex of *Culex pipiens* L. in the United States [*cf. R.A.E.*, B **40** 62]. These comprise two populations of *pipiens* (*s. str.*) from Maryland and Michigan, respectively, one of *fatigans* Wied., for which the author uses the name *quinquefasciatus* Say [*cf. loc. cit.*], from Texas, and one with morphological characters intermediate between those of *pipiens* and *fatigans*, probably originating from Alabama. The colonies were kept at 78–82°F. and the females were fed on pigeons or ducks. Experiments were carried out to test the effect of exposure for five minutes to high temperatures on the survival of the immature stages of the four populations. Preliminary experiments on *Aëdes aegypti* (L.) and *Anopheles quadrimaculatus* Say indicated that the thermal death point might be useful in distinguishing between different kinds of mosquitos and that response to temperature might be a means of explaining their geographical distribution. Results obtained with the four *Culex* populations showed that there were significant differences in resistance to heat only in the egg stage. Eggs of the Texas and Alabama strains were more resistant than

those of the other two, and these strains showed a correlation between resistance to heat and the locality of origin, whereas the eggs of the Michigan *pipiens* were more resistant than those of the Maryland *pipiens*. The temperatures required for 50 per cent. mortality of larvae and pupae of each strain were estimated to fall between 41·3 and 42·3°C. [106·34 and 108·14°F.].

No significant difference could be detected in the reactions of the immature stages of Michigan *pipiens* and the Alabama strain to short exposures to low temperatures. Recently laid eggs of both populations were killed by exposure for 18 hours to 2–2·5°C. [about 36°F.] and for a little over 36 hours to 6–6·5°C. [about 43°F.], but mature eggs resisted exposure for six days to 2–2·5°C. Larvae of both these strains succumbed readily to exposure for three days to 2–2·5°C. Pupae were more resistant to cold than larvae, but no adults emerged at 6–6·5°C. and the pupae died from exposure for a little over 120 hours to that temperature. The two populations, reared at a constant temperature of 56·2–57·2°F., showed no significant differences in developmental or survival rates. The aquatic stages of both were successfully reared at a water temperature of 12·5–13°C. [about 55°F.], and mating, feeding and oviposition occurred normally at an air temperature of 61°F. There were no differences in the rates of survival and development of the immature stages of the Alabama and Michigan strains bred from egg to adult at constant high sublethal temperatures. About 16 per cent. of the larvae of both could be reared to adults at a water temperature of 31·5–32°C. [about 89°F.], while only about 5 per cent. reached the adult stage at 33°C. [91·4°F.]. A temperature of 35°C. [95°F.] was lethal to recently laid eggs of both mosquitos. At a constant temperature of 31·5–32°C. and a relative humidity of 93 per cent., mating, feeding and oviposition were normal in Texas *fatigans* but no mating took place in Michigan *pipiens* or in the Alabama mosquitos. This difference in ability to mate at high temperatures is suggested as an explanation of the absence of *pipiens* from the tropical regions where *fatigans* exists. The absence of *fatigans* from the colder regions is explained by its inability to hibernate like *pipiens pipiens*, or to breed autogenously under adverse conditions in cellars and underground places like *pipiens molestus* Forsk.

Successful crossings of various combinations of the four strains were carried out. Hybrids obtained by interbreeding of Michigan *pipiens* with the Alabama strain were reared to the third filial generation without any diminution in their productive activities. The other hybrid lines, resulting from the crossing of Texas *fatigans* with the other three populations, were taken to the second filial generations, which produced fertile third-generation egg rafts. These results are corroborated by the observation of various workers that in nature transitional forms are found in the region where *C. pipiens* and *C. fatigans* overlap and by the breeding over a year and a half of an apparently hybrid strain like the Alabama one in the laboratory in which the author works.

The author concludes that the morphological as well as the physiological differences among the populations that formed the subject of this investigation are infraspecific in nature, that the mosquitos from Maryland and Michigan should be regarded as *C. pipiens pipiens* and those from Texas as *C. pipiens fatigans* (*quinquefasciatus*) and that the Alabama population was a hybrid with physiological characteristics more like those of *pipiens* than those of *fatigans*. He also considers that *molestus* (*autogenicus* Roub.) is a subspecies of *C. pipiens*.

MELNICK (J. L.). **Isolation of Poliomyelitis Virus from single Species of Flies collected during an urban Epidemic.**—*Amer. J. Hyg.* **49** no. 1 pp. 8–16, 1 graph, 16 refs. Lancaster, Pa., 1949.

An epidemic of poliomyelitis in an urban area in Illinois was at its peak in late August 1945 and had practically ceased by October. In an attempt to

determine possible relations between individual species of flies and the disease, over 93,000 flies were trapped at random throughout the area during successive periods of 13, 14, 14 and 11 days, beginning on 20th August, frozen and stored. During the ensuing months, they were identified and examined for poliomyelitis virus by inoculation of monkeys. The results showed that the virus was present in *Lucilia* (*Phaenicia*) *sericata* (Mg.) and *Phormia regina* (Mg.) in the first period, in *P. regina*, *Musca domestica* L. and *Sarcophaga* spp. in the second, and in *Cynomyia* (*Cynomyopsis*) *cadaverina* R.-D. in the fourth. No positive result was obtained from any species taken in the third period. *L. sericata* and *P. regina* each represented 20–24·5 per cent. of the flies taken in each of the four periods, whereas *M. domestica* and *Sarcophaga* represented only 2·9 and 3·6 per cent. in the period in which they were shown to contain virus. *C. cadaverina* represented 0, 0, 0·8 and 10·5 per cent. of the flies in the successive periods ; its infection in the last period (30th September–10th October), when the epidemic was almost over, suggests that the virus may possibly overwinter in it. It is evident that the finding of virus in a particular species is not a reflection of numerical prevalence.

Brief notes by L. R. Penner on the bionomics of the five species in which the virus was found are appended. All of them feed on human excrement. *C. cadaverina* is usually more abundant in spring and autumn than at other times and is thought to overwinter in the pupal stage.

DE RODANICHE (E. C.) & RODANICHE (A.). **Studies on Q Fever in Panama.**—*Amer. J. Hyg.* **49** no. 1 pp. 67–75, 24 refs. Lancaster, Pa., 1949.

Details are given of two indigenous cases of Q fever studied in Panama in 1947, and of the properties of a strain of *Rickettsia burneti* isolated in guineapigs from one of them. The possible mode of transmission of the infection is also discussed. Both cases occurred during the dry season, when ticks are most prevalent, but neither patient had noticed any tick bites. One had occasion to travel widely on dusty roads past cattle farms, but the other had not left the City of Panama during the incubation period of the disease. However, cattle are transported in open trucks through the streets to the slaughterhouse, and conditions thus seem favourable for transmission by inhalation of dried tick faeces deposited on cattle hairs [*cf. R.A.E.*, B **31** 106]. *Amblyomma cayennense* (F.), which commonly attacks both cattle and man in Panama, has been shown to transmit Q fever in the author's laboratory.

[KRASTIN (N. I.).] **Крастин (Н. И.). The Decipherment of the Cycle of Development of the Nematode *Thelazia gulosa* (Railliet et Henry, 1910), a Parasite of the Eyes of Cattle.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **70** no. 3 pp. 549–551, 2 refs. Moscow, 1950.

Following the discovery that *Thelazia rhodesi* is transmitted by *Musca convexifrons* Thoms. [*R.A.E.*, B **39** 205], investigations were carried out in 1949 in the region of Blagoveshchensk, where *T. rhodesi* does not occur, on the intermediate hosts of *T. gulosa* and *T. skrjabini*, two other nematodes that cause inflammation of the eyes of cattle in the Soviet Far East. Flies frequenting the eyes and nose of cattle were collected between 25th July and 16th August. On examination, about 80 per cent. of them proved to be *Musca amica* Zimin (1951), and the other four species represented did not include *M. convexifrons*. The heads of nearly 6,900 examples of *M. amica* were dissected in saline, and 30 infective *Thelazia* larvae issued from them. Four more were obtained from another batch of an unknown number of *M. amica*, but none from any of the other flies. The larvae could not be specifically identified, but when 12 of them were introduced in mid-August into the conjunctival sac of the left eye of a

healthy calf that was kept isolated from flies and slaughtered at the end of September, a female of *T. gulosa* was found in the lachrymal ducts of the left eye. *M. amica* was thus shown to be an intermediate host of *T. gulosa*. The life-cycle of the latter appears to resemble that of *T. rhodesi* [*cf. loc. cit.*]. The larvae are ingested by the flies with the lachrymal exudate and develop in the organs of the body cavity. Encysted larvae were observed in females of *M. amica*, and the cysts are probably the egg follicles. No larvae were observed in males. On reaching the infective stage, the larvae rupture the follicles and migrate to the head and proboscis.

Brief descriptions are given of the female and the infective larvae of *T. gulosa*. The mouth capsule of one of the infective larvae found was small and cylindrical and resembled that of *T. skrjabini*. Since these two nematodes have similar areas of distribution and frequently occur together in the same eye of an infested animal, it seems probable that *T. skrjabini* is also transmitted by *M. amica*.

Chamberlain (R. W.) & Sikes (R. K.). **Laboratory Rearing Methods for three common Species of Bird Mites.**—*J. Parasit.* **36** no. 5 pp. 461–465, 3 figs., 3 refs. Lancaster, Pa., 1950.

As living bird mites in various stages of development were needed for virus transmission experiments, colonies of *Leiognathus* (*Liponyssus*) *sylviarum* (C. & F.) and *Dermanyssus gallinae* (Deg.) were established from stock collected in Kansas and Colorado and a colony of *Bdellonyssus* (*L.*) *bursa* Berl. from material collected in Alabama. Details are given of the rearing chamber used, which was modified from one devised for rearing *B.* (*L.*) *bacoti* (Hirst) [*R.A.E.*, B **38** 211–212], and a diagram of a simple aspirator for transferring the mites is included. Purified mineral oil or distilled water was used in the moat. Autoclaved, dried grass was used in the bottom of the chamber, and the host was a young chick. This had to be replaced fairly frequently by one less than a week old to prevent excessive contamination of the grass by the faeces of older chicks. A temperature of 80–83°F. was suitable for both chicks and mites.

D. gallinae is the most easily maintained species, as it feeds quickly and then goes into hiding. Pieces of corrugated cardboard between the grass and the sides of the chamber provide suitable sites for hiding and oviposition. A chick may be left continuously in the chamber or placed there overnight once or twice a week. When mites are needed for experiment, they can be brought out of hiding by removing the chick for three or four days and then taken from the corners and rim of the chamber with the aspirator, or they can be collected from the cardboard. *B. bursa* is hardy and easily maintained, and appears to lay most of its eggs in the litter. A colony was maintained for over three months in spite of accumulated chick faeces. It is best to keep about three colonies going so that one may be discarded and one set up anew each month. *L. sylviarum* is more difficult to maintain, as oviposition appears to take place mainly on the host and the humidity requirements are more exacting. Also, oil in the moat is destructive to it.

Wood (S. F.). **Dispersal Flight of *Triatoma* in southern Arizona.**—*J. Parasit.* **36** no. 5 pp. 498–499. Lancaster, Pa., 1950.

In view of the fact that bugs of the genus *Triatoma* enter houses and inflict painful bites on man, information on their dispersal flights from localities where they are associated with rodents is reviewed from the literature, from the author's observations in Arizona and from observations communicated to him. Dispersal is shown to be associated with high temperature and high humidity.

Chamberlain (R. W.) & Sikes (R. K.). **A safe Method of handling Mosquitoes for Virus Transmission Experiments.**—*J. Parasit.* **36** no. 5 pp. 499–500. Lancaster, Pa., 1950.

The method described for keeping and handling female mosquitos during virus transmission studies has been tested on *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) and found to prevent injury to the mosquitos and to minimise the risk of accidental transmission of virus by eliminating unnecessary transference. Female pupae in batches of up to 100 are separated from males on the basis of size, and each batch is put into a cylindrical, pint-sized carton the bottom of which has been replaced with waxed bobbinet, secured by the cardboard ring from the carton cover. The carton is then put in a pan containing a little water, so that the pupae swim freely. Bobbinet also forms a top to the carton. When the adults have emerged, the number surviving is determined. Moisture is provided by a damp pad on the bobbinet top, and a soaked raisin placed under the pad two nights each week serves as food.

Blood-meals have been provided by normal and infected baby chicks, suspended in muslin bags so that the plucked breast, which is exposed by a hole in the bag, rests on the bobbinet. A lining of absorbent cotton can be used to keep the chick warm and absorb discharges. If the chick is left in position overnight, more than 90 per cent. of the females usually feed. Unfed females and accidentally retained males can easily be removed with a curved aspirator inserted through a hole in the side of the carton. It is best to do this with the arms inside a safety cage, which is briefly described. If the engorged females are to be refed on another chick after digestion of the first meal, they may be allowed to do so without ovipositing, or oviposition may be induced by placing the carton in a shallow pan of water overnight. Many females usually drown during oviposition, unless there are less than 50 in the carton. If it is desired to retain egg rafts, they can be removed with a wet pipe-cleaner while floating. Females have been kept alive in these containers for more than 60 days at a relative humidity of 70–80 per cent. and a temperature of 74–83°F.

Ziony (M.). **Malaria Control in Iran. Résumé of Reports made by Dr. Justin M. Andrews and Lawrence B. Hall.**—*Publ. Hlth Rep.* **65** no. 11 pp. 351–367. Washington, D.C., 1950.

About a quarter of the people of Persia (some 880,000 families) live in intensely malarious villages. The disease is particularly prevalent near the Caspian Sea and in areas with irrigated river valleys or impounded waters. Many species of *Anopheles* have been recorded from Persia, but only *A. superpictus* Grassi, *A. maculipennis* Mg. (including var. *sacharovi* Favr) and *A. stephensi* List. are thought to be of significance as vectors [*cf. R.A.E.*, B **33** 16 ; **34** 181, 201–202]. In the north, the transmission season extends from May to October with the peak in July. The prevailing species of *Plasmodium* in August and September is *P. falciparum*. In the south, the season starts earlier and ends later.

Efforts at malaria control made between 1944 and J. M. Andrews' inspection in 1948 are reviewed, and the measures that he recommended to the government are summarised. He proposed that a programme of Anopheline control by spraying the insides of houses and shelters for domestic animals with DDT to leave a toxic deposit should be developed in three stages. First, there should be a demonstrational phase lasting one year (1949), during which about 92,000 houses in areas where malaria was known to be hyperendemic should receive two applications of 5 per cent. DDT in oil or (to compare its effect) one application of DDT in wettable-powder suspension, mainly at the expense of the national government, working through provincial health

organisations and with the co-operation of voluntary agencies. Then there should be an operational phase during which similar measures should be extended to every village with a serious malaria problem, the costs being shared between the government and the landowners. It was proposed to spray 350,000 houses in 1950, 620,000 in 1951 and the whole 880,000 in 1952. Finally, during a maintenance phase, inconspicuous areas of endemicity should be located and dealt with, attempts should be made to extend any areas found to have become free of malaria or vectors, and advice should be given to those concerned in the development and operation of irrigation systems. It is recommended that a malaria control unit be set up to provide technical assistance. Notes are given on the establishment of the first phase by L. B. Hall in 1949, and the recommendations made by him are summarised.

Seddon (H. R.). **Diseases of domestic Animals in Australia. Part 1. Helminth Infestations.**—*Serv. Publ.* (*Div. vet. Hyg.*) *Dep. Hlth Aust.* no. 5, 223 pp., 16 pls. (1 fldg.), 9 fldg. maps, refs. Canberra, 1950. **Part 2. Fly, Louse and Flea Infestations.**—*Op. cit.* no. 6, 173 pp., 18 figs., 18 maps (3 fldg.), refs. 1951.

The first of these two parts of a proposed comprehensive work on the diseases of domestic animals in Australia deals with the helminths that infest domestic animals and poultry there, and information on their life-histories includes reference to the Arthropod hosts of those that have them.

In the second part, the Diptera, lice and fleas that are injurious to domestic animals and poultry in Australia are reviewed as individual species or groups of species, and notes are given on such points as their distribution and abundance, in so far as these are known, their bionomics as observed in Australia, the effects they produce on the host or the diseases or parasites they carry, the circumstances in which the effects are most serious and the control measures generally used, if any. Those dealt with in most detail are *Siphona exigua* (de Meij.) on cattle, and *Melophagus ovinus* (L.) and blowflies on sheep.

Papers noticed by Title only.

Forgash (A. J.). **The Effect of Insecticides and other toxic Substances upon the reduced Glutathione of** *Periplaneta americana*.—*J. econ. Ent.* **44** no. 6 pp. 870–878, 5 graphs, 15 refs. Menasha, Wis., 1951. [See *R.A.E.*, A **40** 102.]

Metcalf (R. L.). **The colorimetric Microestimation of Human Blood Cholinesterases and its Application to Poisoning by organic Phosphate Insecticides.**—*J. econ. Ent.* **44** no. 6 pp. 883–890, 5 graphs, 21 refs. Menasha, Wis., 1951. [See *R.A.E.*, A **40** 104.]

Eden (W. G.). **Toxicity of Dieldrin** [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethanonaphthalene] **to Chickens.**—*J. econ. Ent.* **44** no. 6 p. 1013, 2 refs. Menasha, Wis., 1951. [See *R.A.E.*, A **40** 121.]

Common Names of British Insect and other Pests. Part two. Lice : Thrips : Plant Bugs, Aphids and Scale Insects : Butterflies and Moths : Fleas : Mites and Ticks.—40 pp. Association of Applied Biologists, 1952. Price 3*s*. (Copies obtainable from Miss B. M. Stokes, Rothamsted Experimental Station, Harpenden, Herts.) [*Cf. R.A.E.*, A **35** 194.]

Nicholson (H. P.) & Mickel (C. E.). **The Black Flies of Minnesota (Simuliidae).**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 192, 64 pp., 32 figs., 46 refs. [St. Paul] Minn., 1950.

The introductory sections of this paper comprise an account of the general bionomics of Simuliids, based mainly on the literature, but supplemented by the authors' own observations, and a review of their economic importance throughout the world and in Minnesota, with reference to early accounts of the harm they do. They cause considerable loss to the dairy and tourist industries in Minnesota, and, among blood-sucking insects, probably rank next to mosquitos and Tabanids as pests. In North America, in addition to causing annoyance to man and direct harm to stock by feeding, they also transmit *Leucocytozoon smithi* to turkeys in the United States [*R.A.E.*, B **26** 188 ; **28** 173 ; **31** 103] and *L. simondi* (*anatis* [**27** 64]) to ducks in the United States and Canada [**21** 92 ; **22** 108]. *L. simondi* is transmitted by *Simulium venustum* Say and *L. smithi* by *S. occidentale* Tns. and *S. jenningsi* Mall., of which *S. nigroparvum* Twinn has been found to be a synonym. Leucocytozoon disease has been observed in ducks in widely scattered parts of Minnesota since about 1935 and occurred in turkeys at one place there in 1947. The production of poultry, particularly turkeys, is a large and growing industry in the State. The three known vectors all occur there, and *S. venustum*, at least, is widely distributed and common.

The main section contains descriptions of the 18 species of Simuliids that are known in Minnesota, with keys to them. Two species and one subspecies are new.

Gillard (A.). **Les tiques et la babésiellose bovine à la Réunion.**—*Rev. agric. Réunion* (N. S.) **49** pp. 5–11, 51–58, 4 fldg. charts. Saint-Denis, 1949.

The ticks known in Réunion are *Argas persicus* (Oken), which is abundant in fowl houses, particularly on the coast, *Rhipicephalus sanguineus* (Latr.) on dogs, *Boophilus decoloratus* (Koch), which is the commonest species on cattle, and *Amblyomma variegatum* (F.), of which cattle are the preferred hosts. The life-cycles of each of the first three and of an example of the genus *Amblyomma* are shown diagrammatically. That of *A. variegatum* is not precisely known. The two species on cattle are particularly abundant from December to March, during the rains. *A. variegatum* is confined to fairly low altitudes and is believed to play an important part in the transmission of ulcerous lymphangitis, which is comparatively frequent on horses in the coastal region. *B. decoloratus* occurs in large numbers on the coast and the uplands and transmits bovine piroplasmosis. This disease was first recorded from Réunion in 1941 but had probably been there unrecognised for a long time. It is confined to the coastal region and it is believed to have been introduced from Madagascar [*cf. R.A.E.*, B **24** 100]. The symptoms are described. The disease is always fatal if left untreated but can easily be cured if treated early. Animals can also be protected by inoculation. The usual methods of tick control are given. Dipping should be carried out weekly on the coast and fortnightly on the upland plains.

Ferris (G. F.). **The Sucking Lice.**—*Mem. Pacif. Coast ent. Soc.* **1** 10×6¾ ins., ix+320 pp., 124 figs., refs., multigraph. San Francisco, Calif., 1951. Price $6.

A section of nearly 50 pages on the morphology and anatomy of adult Anoplura is followed by briefer descriptions of the eggs and nymphal instars, and by surveys of the development of knowledge on the taxonomic status of the group and of opinions on its classification. The families, subfamilies, genera and species are then reviewed (pp. 71–285) ; keys are given to them, and all

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available genotypes and the species occurring on domestic animals are figured. The taxonomic part of the work is based on a series of studies published by the author over a period of years [*R.A.E.*, B **8** 71 ; **10** 11 ; **11** 214, 215 ; **22** 205 ; **24** 14]. Particular attention is given to species occurring on man and other primates, and suggestions are made for further research on the genus *Pediculus* on man and American monkeys. The concluding chapters comprise a list of the mammals from which Anoplura are known, showing the species occurring on each, and a discussion of host relations and distribution.

MARKE (D. J. B.) & LILLY (C. H.). **Smoke Generators for the Dispersion of Pesticides.**—*J. Sci. Fd Agric.* **2** no. 2 pp. 56–65, 7 figs., 41 refs. London, 1951.

The experiments described were carried out to develop mixtures reacting at relatively low temperatures for the generation of insecticidal smokes. In preliminary tests, BHC (benzene hexachloride) and DDT incorporated in pellets of a mixture of ammonium nitrate and potassium chromate, which react at about 350°C. on ignition, without flame or incandescence, gave 100 and 86 per cent. mortality, respectively, of house-flies (*Musca domestica* L.) exposed to deposits of the resulting smoke on paper, as compared with 0 and 0 in an inflaming mixture of potassium nitrate, sulphur and charcoal and 78 and 11 per cent. in a mixture of hexachloroethane, zinc oxide and calcium silicide of the incandescent smoke-producing type ; when the insecticides were dispersed (for comparison) from burning safety fuse, the percentages were 100 and 94.

Further tests of technical BHC (13–14 per cent. γ isomer) and technical DDT in a wide range of mixtures of ammonium nitrate and potassium chromate showed that increasing the content of potassium chromate favoured easy initiation of the reaction and allowed a larger proportion of insecticide to be introduced into the mixture ; the reaction temperature did not vary much with change in chromate content, but was lowered by increasing the proportion of insecticide. Only up to 10 per cent. DDT or 40 per cent. BHC could be used without incurring failure of initiation, but 50 per cent. of either could be introduced when mixtures of ammonium nitrate and ammonium dichromate were used as the heater component. In these mixtures, the reaction temperature tended to rise as the ammonium-dichromate content was increased, but the initiation could be improved and the reaction cooled by adding cuprous chloride. When the ammonium-dichromate content was raised above 15 per cent. in DDT mixtures, reaction temperatures up to 700°C. occurred, but such high temperatures were avoided by adding as little as 0·5 per cent. magnesium oxide, and it appeared that they might be due to the reaction of DDT itself, with liberation of hydrochloric acid. Similarly high percentages of insecticide could be incorporated in ammonium nitrate sensitised with charcoal or in guanidine nitrate or nitroguanidine sensitised with ammonium dichromate, and ammonium dichromate alone could disperse 20–40 per cent. insecticide at low reaction temperatures. The mixtures were mostly tested with BHC and DDT, but it was found that azobenzene and parathion could be dispersed by them ; the parathion was incorporated in an absorbent medium and then added to the heater mixture.

The toxicity of smoke deposits was tested by exposing glass plates for two hours on the floor of brick smoke-cells, in which the smokes were generated by remote control, and confining adults of *Tribolium castaneum* (Hbst.) on them for one hour ; 27–50 per cent. BHC in mixtures of ammonium nitrate with potassium chromate, ammonium dichromate or charcoal or of ammonium dichromate with guanidine nitrate or nitroguanidine gave comparable results (77–93 per cent. kill), and 45–50 per cent. DDT in mixtures of ammonium nitrate with charcoal or of ammonium dichromate with guanidine nitrate or nitroguanidine gave 96, 83 and 64 per cent., but 30 per cent. BHC in ammonium dichromate

alone gave only 36 per cent. The deposit densities were found by exposing glass plates coated with wax on the floor for two hours during smoke deposition, washing the plates with benzene and determining the BHC by estimating the hydrolysable chlorine or the γ isomer by a polarographic method. A good statistical correlation was found between the density determinations and the insect kills, and the median lethal deposit of BHC from an ammonium-nitrate and potassium-chromate mixture was 12 mmg. per sq. cm. Exposing plates on the walls and ceiling showed that deposits were much lower there than on the floor, and the resulting kills of *T. castaneum* by BHC were only 8 per cent. as compared with 91 per cent. on the floor. Comparison of glass, cloth, glossy and ordinary wall-paper and smooth and rough fibreboard exposed in the smoke-cell showed that deposits on smooth surfaces generally gave higher kills than those on rough ones, and storage of the plates for 30 days that DDT deposits retained their toxicity on non-absorbent surfaces (glass) but lost it rapidly on absorbent ones (pressed board), whereas the toxicity of the BHC deposit was not markedly affected by the nature of the surface, but fell off steadily between the two extremes for DDT ; the pure γ isomer was less persistent than the mixed isomers of BHC. The types and particle sizes of deposits from the different mixtures were investigated. Most of the particles deposited from mixtures of BHC, ammonium nitrate and potassium chromate were 6 μ or more in diameter, and more than 90 per cent. of them were deposited in two hours. The DDT was deposited in the form of liquid drops that crystallised on being touched. Repeated exposure of insects to the same deposits on glass showed a rapid initial drop in toxicity for both substances, that for DDT being probably due to the difference in toxicity between the supercooled drops of the initial deposit and the crystals formed by exposure to the first insects, and that for BHC to its high vapour-pressure.

One of the advantages of the mixtures tested was the ease of initiation of the reaction ; they proved safe to manufacture and use, with no risk of explosion, and were appreciably more stable than chlorate mixtures during exposure to temperatures up to 120°C. Ways in which they can be prepared for use are briefly discussed.

Babers (F. H.) & Pratt jr. (J. J.). **Studies on the Resistance of Insects to Insecticides. I. Cholinesterase in House Flies** (*Musca domestica* **L.) resistant to DDT.**—*Physiol. Zool.* **23** no. 1 pp. 58–63, 2 graphs, 28 refs. Chicago, Ill., 1950.

The following is based on the authors' summary. The cholinesterase activity in the heads of house-flies (*Musca domestica* L.) of a strain resistant to DDT was lower during the first five days after emergence than that in normal house-flies. On a weight basis, males in both resistant and normal colonies showed more cholinesterase activity than females. The activity varied from day to day, but no regular pattern was observed. Acetylcholine was hydrolysed about twice as fast as acetyl-β-methylcholine and about seven times as fast as benzoylcholine. The reaction was inhibited by excess substrate, and the optimum pH for the enzyme was about 5·75. Little change in rate was noted between pH 6·25 and pH 9·0.

[Pavlov (P.) & Georgiev (B.).] **Павлов (П.) и Георгиев (Б.). Recherches sur les ixodicides HCH, DDT, Gesarol et Dedetex puder. Ie communication.** [*In Bulgarian.*]—*Rev. Inst. Rech. sci.* **18** pt. 1 pp. 107–118, 20 refs. Sofia, 1950. (With Summaries in Russian and French.)

In laboratory experiments in Bulgaria in 1949, dusts of 5 per cent. BHC (benzene hexachloride) or DDT were tested against adults or eggs of *Rhipicephalus bursa* C. & F., *Hyalomma marginatum* Koch and *Argas persicus* (Oken).

When applied to adults of the three species in jars, BHC killed a high proportion of males and unfed females and immobilised the rest in 24 hours and killed partly engorged and engorged females in 2–5 and 6–15 days, respectively. *A. persicus* succumbed sooner than the others, but none of the dusted females oviposited. DDT killed the unengorged, partly engorged and engorged females in a little over 24 hours, 3–5 days and 10–15 days, but five of the nine engorged females of *R. bursa* oviposited on the tenth day after dusting, and the eggs, which were transferred to clean paper, gave rise to viable larvae.

When adults of *R. bursa* and *H. marginatum* were placed in jars on filter paper that had been dusted with BHC or DDT, the males and unfed females died in 48 hours and the partly engorged and engorged females in 4–8 and 24 days, but one of the four engorged females of *H. marginatum* exposed to BHC and two of the four of *R. bursa* exposed to DDT laid normal numbers of eggs six days after the beginning of the test, and the resulting larvae were viable. Engorged females of these two species that were dusted with BHC, washed in plain water 24 hours later, allowed to dry and then placed in jars died 10–16 days later without ovipositing, whereas all those that were dusted with DDT and similarly treated oviposited five days later ; in the latter test, one female of *R. bursa* among the control ticks which were dusted but not washed, also oviposited in 7 days. The larvae were viable in all cases.

Eggs of *H. marginatum* and *R. bursa* that were dusted with BHC or DDT all died, but those that were placed on dusted paper gave rise to viable larvae, though hatching was delayed and reduced by BHC.

In an experiment in which females of *A. persicus* were dusted immediately after having engorged, to determine whether such ticks have greater resistance, all those treated with BHC died within 24–28 hours, whereas 80–90 per cent. of those dusted with DDT survived.

Concurrently, similar tests were carried out with Gesarol [which contains DDT] and Dedetex, a powder of unknown composition with an odour of BHC. They proved about as effective as the dusts containing 5 per cent. DDT and BHC, respectively.

MILNE (A.). **The Ecology of the Sheep Tick, *Ixodes ricinus* L. Host Relationships of the Tick. Part 1. Review of previous Work in Britain.**—*Parasitology* **39** no. 3–4 pp. 167–172, 33 refs. London, 1949. **Part 2. Observations on Hill and Moorland Grazings in northern England.**—*T.c.* pp. 173–197, 25 refs.

The following is based on the author's summary of the first part. A study of the rather inadequate published data on the hosts of *Ixodes ricinus* (L.) in Britain shows that it has been found on 23 species of mammals, 21 species of birds and a lizard. The length and variety of the list suggest that the tick will feed on practically any mammal or bird. The stages found have been recorded for 15 species of mammals, all the birds and the lizard. There were indications that whereas larvae and nymphs are found on mammals and birds, adults tend to occur on mammals only [*cf. R.A.E.*, B **27** 243]. However, reasons are given for treating this conclusion with reserve.

There are no precise data on the proportions of the tick population on a typical hill grazing that are supported by the different host species present. The data available from the publications of two workers [**27** 92, 242] seem to suggest that, at the population levels usually maintained, grouse are negligible as compared with sheep as hosts of female ticks and that Scottish mountain hares (*Lepus timidus*) and red deer may play an important part in maintaining female ticks. However, in view of their inadequacy, little reliance is placed on at least the second suggestion, and comprehensive investigation of the problem is urged before any policy of slaughtering wild fauna is adopted [**27** 93, 243]. An account is given of an experiment by MacLeod [**23** 92], which showed that an appreciable tick population can be maintained on a hill

grazing by a reduced wild fauna in the absence of sheep, and the application of his method to more precise studies is discussed. Reference is also made to an experiment by W. Moore, in which the tick population of a grazing was considerably reduced by dipping of sheep combined with destruction of almost all hares and roe deer. However, it is impossible to assess the proportion of the result attributable to each of the measures.

The second part consists of an account of the author's own observations in northern England in 1943–46. The grazings on which the studies were made are described. They consist of 97 per cent. grass and heather with bracken and 3 per cent. plantation and scrub. Although three other species of *Ixodes* were found, *I. ricinus* was by far the most important tick on all hosts (wild and domestic) and is the only species considered in this work. The previous lists of British mammal and bird hosts were largely confirmed and increased by six and 18 species, respectively. Most of the new hosts were small. The list does not include some species in the British fauna that have been recorded as hosts elsewhere, and the suggestion that the tick will attach itself to any bird or mammal it may meet is strongly reinforced. No ticks were found on adders, frogs or toads. Only the larger mammals and birds served as hosts for adult female ticks. They included three wild birds. The preponderance of mammalian over avian hosts for the adults is attributed to a lack of bird species that are large enough. All recorded hosts appear to be hosts of larvae and all except shrew, and possibly mole, of nymphs. Birds keep themselves free of ticks wherever their beaks can reach. Small mammals also probably rid themselves of part of their infestations. In any host species, there is great variation in infestation among individuals on the same ground at the same time. In general, the smaller the host, the lower the average infestation of any one stage. This is probably a function of the amount of ground covered in unit time [*cf.* **39** 44].

The sheep is the chief farm-animal host on hill grazings. An individual sheep feeds very many more female ticks than the most heavily infested wild host except red deer. From a detailed study of infestation of sheep and other hosts running on the same ground, it is concluded that the percentage of female ticks feeding on wild hosts on hill grazings in northern England is between 0·8 and 5·6, so that the sheep flock feeds 94–99 per cent. of the female ticks, the higher figure probably being more nearly accurate. The part played by the young of hosts is discussed with the conclusion that confining the study to adult animals does not appear to have caused an underestimate of the part played by wild hosts. The wild hosts support proportionately more of the nymphs than they do of adults and still more of the larvae.

Salient points emerging from the study are that control can be most effectively directed against the female ticks, that birds are of no importance as hosts of female ticks, and that there is no evidence of necessity to extirpate or even reduce any of the wild mammalian hosts. If acaricidal treatment were serially applied to hill flocks [*cf.* **34** 183] so that no attaching females escaped, the breeding section of the tick ground population would be reduced by over 94 per cent. per year, whence control would inevitably follow. In view of the tick's wide range of hosts, eradication cannot be expected. Withdrawing sheep would be less rapidly effective as it would increase infestation on wild hosts. It is probable that these conclusions hold good for the whole of Britain, except that further study may indicate that it would be desirable to reduce the population of red deer and mountain hares in a few areas of Scotland.

Lewis (D. J.). **The Distribution of Cimicidae (Hemiptera) in the Anglo-Egyptian Sudan.**—*Parasitology* **39** no. 3–4 pp. 295–299, 4 maps, 34 refs. London, 1949.

Observations on the distribution of bed-bugs in the Anglo-Egyptian Sudan, made over a period of ten years, showed that *Cimex hemipterus* (F.) is

widespread in the south and along the coast 500 miles further north, while *C. lectularius* L. is widespread in the inhabited parts of the northern Sudan, except near the coast, and also along lines of communication in the south. It is the common bed-bug in many places 800 miles south of the Tropic of Cancer and not uncommon 1,100 miles south of it. In areas where both are found, *C. hemipterus* occurs among the local native population and *C. lectularius* among the people of northern origin or local people who have much contact with them. The bugs are sometimes extremely numerous. Detailed records of each species are given, and the probable reasons for their distribution are discussed. The main factors are thought to be facilities for dispersal and atmospheric humidity. One or two individuals were found in which the shape of the prothorax was intermediate between *C. lectularius* and *C. hemipterus*. *Leptocimex boueti* (Brumpt) was found in two localities and is probably more widely distributed.

Davies (D. M.). **Some Observations of the Number of Black Flies (Diptera, Simuliidae) landing on colored Cloths.**—*Canad. J. Zool.* **29** no. 1 pp. 65–70, 2 pls., 2 graphs, 7 refs. Ottawa, 1951.

In field tests made in 1947 in Ontario, the numbers of Simuliids alighting on cloths of different colours, each tested on the human body with a control of black cloth, were more affected by the intensity of light reflected from the cloth than its wavelength. Dark blue was the colour most frequented, and was followed by dark brown, black, dark green, dark red, medium grey and white. Over 90 per cent. of the Simuliids in the area at the time were *Simulium venustum* Say.

Haddow (A. J.). **Further Observations on the Biting-habits of Tabanidae in Uganda.**—*Bull. ent. Res.* **42** pt. 4 pp. 659–674, 3 graphs, 9 refs. London, 1952.

Further information on the biting habits of *Chrysops centurionis* Aust. [*cf. R.A.E.*, B **38** 141] and its distribution in Uganda is given on the basis of 240 24-hour catches made in the Semliki Forest, Bwamba County, and collections in other parts of Uganda up to the end of 1949. The species occurred over a wide area and was everywhere arboreal and mainly crepuscular. No males have been found in nature.

Filaria (*Loa*) *loa* does not occur in man in Uganda, and the eastern limit of its known distribution in the Belgian Congo is where *C. centurionis* replaces the two vectors, *C. silacea* Aust. and *C. dimidiata* Wulp. These are closely allied to *C. centurionis*, but differ in feeding habits in that they sometimes bite at ground level and, like the microfilariae of *F. loa*, are diurnal. If, however, the filariae of monkeys in Uganda possibly transmitted by *C. centurionis* [*loc. cit.*] should prove to be *F. loa*, its distribution in monkeys must be wider than in man, and the Tabanid presumably acquires infection when feeding in late afternoon.

The peculiar biting-cycle of a scarce Tabanid, *Haematopota nefanda* Edw., is briefly described, and short notes are given on the biting habits and distribution of some other Tabanids.

Lumsden (W. H. R.). **The crepuscular Biting Activity of Insects in the Forest Canopy in Bwamba, Uganda. A Study in Relation to the Sylvan Epidemiology of Yellow Fever.**—*Bull. ent. Res.* **42** pt. 4 pp. 721–760, 6 graphs, 28 refs. London, 1952.

The following is based on the author's summary. The results are given of a series of catches of blood-sucking Diptera at human bait on five platforms in

the lower and middle zones of the forest canopy at Mongiro on the edge of the Semliki Forest in Bwamba County, Uganda. The platforms were in a line about 440 yards long, but were under varying degrees of shade. It was desired to study the effect on the numbers taken of differences in platform, season and weather and particularly the short-term changes in the activity of biting insects near the time of sunset. Each catch lasted from three hours before to three hours after sunset, and the part of it extending from 30 minutes before to one hour after sunset was divided into ten-minute periods. The main analysis is of catches made on 100 evenings, which covered the end of the dry and beginning and end of the wet season in 1948 and the end of the dry season in 1949.

A list of the species of Diptera found is given. The species that were abundant were *Anopheles gambiae* Giles, *Mansonia* (*Taeniorhynchus*) *fuscopennata* (Theo.), *M.* (*T.*) *africana* (Theo.), *M.* (*T.*) *uniformis* (Theo.), *Aëdes nigerrimus* (Theo.), *A. apicoargenteus* (Theo.), *A. africanus* (Theo.) and *Chrysops centurionis* Aust. Data relating to these eight species were subjected to a fairly detailed analysis, and the remaining 27 species or groups of species are discussed shortly. *C. centurionis* and five of the abundant mosquitos showed statistically significant differences between the catches on the five platforms. Arrangement of the five platforms in order of the total numbers taken, for each of these six species, gave results that were practically identical for three (*Anopheles gambiae*, *M. africana* and *M. uniformis*) and for two others (*Aëdes apicoargenteus* and *A. africanus*). However, the arrangements between these two groups differed widely from each other. The arrangement for *C. centurionis* was different from that for either of the groups. No consistent relationship was found between these ordinal arrangements and the obvious characteristics of the platforms. However, the first three species came largely, or perhaps entirely, from breeding places outside the forest, in or near open swamp, while the others are likely to be confined to the forest. Both species of *Aëdes* breed in tree-holes, and dense shade is characteristic of the breeding places of species of *Chrysops* closely related to *C. centurionis*. It is believed that the numbers taken on the different platforms reflect local adult abundance, which in turn is related to the abundance and proximity of breeding places.

Seasonal variations in the numbers of the abundant species were also studied. They are thought to be related to rainfall, through its effect on the profusion of breeding places, at least so far as mosquitos are concerned. Populations of species breeding in tree holes, however, underwent a reduction before the end of the wet season. The extent of the reduction in the numbers of *Aëdes africanus* in the dry season is important in relation to the possibility of the survival of the virus of yellow fever in the mosquito [*cf. R.A.E.*, B **40** 51]. It was estimated that the population in the dry season of 1949 was less than 4·4 per cent. of what it had been at the end of the previous wet season. *C. centurionis* was present throughout the catching period but was abundant only in late March and early April. The theory that this reflected emergence over a very restricted period is supported by the fact that during the period of greatest abundance there are two feeding peaks, one before and the other after sunset. The latter corresponds largely with the peak seen at other seasons. In the course of a discussion of the findings of this work in relation to the general problem of the mechanism controlling the rhythm of activity in insects biting by night and of a hypothesis based on the conception that different population groups may have different biting habits, put forward to account for the different types of cycle commonly met with, it is suggested that the individuals of *C. centurionis* feeding before sunset in March and April are newly emerged and are seeking their first blood-meal and that they differ in their habits from those seeking subsequent blood-meals. The biting activity of *Anopheles gambiae* was depressed by wind and that of *Aëdes africanus* by wind and rain, but *C. centurionis* was little affected by either.

Studies of changes in biting activity in the nine periods of ten minutes extending from 30 minutes before sunset are discussed. Each of the species that was known to be mainly active by night and was abundant enough for study was found to reach its maximum activity shortly after sunset. The peak was clearly marked in *Anopheles gambiae*, *M. fuscopennata*, *M. africana*, *Aëdes africanus* and *C. centurionis* and less so, but still distinct, in *M. uniformis* and *A. nigerrimus*. It occurred earliest (in the fifth period) in *C. centurionis* and latest (in the eighth period) in *M. africana*. In any given species, the peak period of biting changed only slightly in relation to sunset. In analyses of the data by different platforms, by season, and by types of weather, it was the exception to find the time of peak activity to be shifted more than one period from the position that it occupied over the whole series. When the curves of biting activity on individual nights were studied, three consecutive ten-minute periods, centred on the period showing the peak for the whole series, included the peak in 21 of the 23 samples of *Anopheles gambiae* available, in all five of *M. africana*, in eight of 11 of *A. africanus* and in 15 of 20 of *C. centurionis*. The regularity of the occurrence of the peak period of activity in any given species is thought to indicate that it is largely controlled by changes in light intensity about the time of sunset.

Harrison (C. M.). **DDT Resistance in an Italian Strain of *Musca domestica* L.**—*Bull. ent. Res.* **42** pt. 4 pp. 761–768, 3 graphs, 11 refs. London, 1952.

An account is given of the technique and results of laboratory investigations in England on the effect of selection on two Italian strains of *Musca domestica* L. received in 1948 when one (the Torre in Pietra strain) was resistant to DDT [*cf. R.A.E.*, B **38** 129] and the other (Roma strain) was not. Initial tests with the Roma strain showed that flies of 9–10 and 16–19 days old were more susceptible to DDT deposits than flies 4–5 days old, males were more susceptible than females and small flies than large ones. Flies used in the comparative toxicity tests were therefore standard in age and sex and, so far as possible, in size. At the outset of the work, the Torre in Pietra strain was 3·6 times as resistant as the Roma strain to dry deposits of DDT, but after being bred in the laboratory for 22 generations without further exposure to DDT, it was very little more resistant than the Roma strain [*cf.* **38** 159]. The Torre in Pietra strain was as susceptible as the Roma strain to deposits of γ BHC (benzene hexachloride), but was slightly resistant to pyrethrins. The resistance of the Torre in Pietra strain to DDT was increased by selective breeding from individuals that had survived exposure to it, but that of the Roma strain was not. This may have been because the Roma strain was comparatively pure, whereas the Torre in Pietra strain was more heterogeneous, containing susceptible as well as moderately resistant individuals. The selected Torre in Pietra strain (X strain) lost practically none of its resistance in 12 generations without exposure. Selection of the Roma strain by exposure to pyrethrins slightly increased its resistance to pyrethrins, DDT, BHC and chlordan.

Barlow (F.) & Hadaway (A. B.). **Studies on aqueous Suspensions of Insecticides. Part II. Quantitative Determinations of Weights of DDT picked up and retained.**—*Bull. ent. Res.* **42** pt. 4 pp. 769–777, 2 graphs, 6 refs. London, 1952.

In continuation of experiments in which the relationship between the size of DDT particles and their effectiveness against *Aëdes aegypti* (L.) was examined [*R.A.E.*, B **39** 51], the weights picked up by adults of *A. aegypti* and *Glossina palpalis* (R.-D.) in short periods of contact with deposits of 25 mg. DDT per sq. ft. from aqueous suspensions of DDT crystals of different sizes were determined chemically and correlated with mortality rates. The methods used are

described. The speed of action of DDT particles picked up by mosquitos from plaster blocks increased as the size decreased. It is suggested that smaller particles may dissolve more rapidly in the cuticle waxes. When the weight of insecticide picked up was taken into account, the median lethal dosage both for mosquitos and *Glossina* was found to increase with particle size. There was evidence that particles in the 0–10 and 10–20 μ ranges were retained better than larger ones. The availability, and therefore the effectiveness, of deposits was influenced considerably by the type of material to which they were applied. Whereas particles of 0–10 μ were less effective than those of 10–20 μ on plaster, when allowance was not made for weight, the reverse was true on mud blocks. Adhesion of the very small particles to the substrata may have been greater on plaster than on mud. On non-porous surfaces such as glass, the wetting-agent solution remains on the surface, and on drying, the wetting-agent solids hold the insecticide particles so that they are not readily available.

Pringle (G.). **The Identification of the Larvae of *Anopheles stephensi* Liston and *Anopheles superpictus* Grassi in Iraq.**—*Bull. ent. Res.* **42** pt. 4 pp. 779–783, 3 figs., 3 refs. London, 1952.

In Iraq, *Anopheles superpictus* Grassi is almost restricted to the desert-steppe and foothill regions north of 34°N. lat., whereas *A. stephensi* List. is confined to the alluvial plains of the centre and south, but the ranges of the two overlap in certain districts, and the central plain is subject to occasional small-scale invasion by *A. superpictus*. The differentiation of the two species is therefore important, and though the adults are easily distinguished, the larvae are rather similar in chaetotaxy. Various suggested methods of distinguishing them are reviewed from the literature in the light of the author's experience. Examination of a large number of specimens from Iraq having indicated that the relative length of the filaments of the abdominal palmate hairs was the only feature of value, this method was further investigated and found to give accurate results for about 90 per cent. of the larvae.

van Someren (E. C. C.). **Ethiopian Culicidae—Descriptions of four new Mosquitoes from Madagascar.**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 1–2 pp. 3–8, 2 figs., 3 refs. London, 1949.

Descriptions are given of the adults of both sexes, pupa and larva of *Anopheles* (*Myzomyia*) *notleyi* sp. n. and of the adult of one or other sex of three new species of mosquitos belonging to two other genera and of a larva that should probably be associated with one of them.

Roth (L. M.). **Loci of sensory End-organs used by Mosquitoes (*Aedes aegypti* (L.) and *Anopheles quadrimaculatus* Say) in receiving Host Stimuli.**—*Ann. ent. Soc. Amer.* **44** no. 1 pp. 59–74, 6 figs., 18 refs. Columbus, Ohio, 1951.

The following conclusions are drawn from the results of experiments in which females of *Aëdes aegypti* (L.) and *Anopheles quadrimaculatus* Say were offered a first blood-meal on the human arm and hand, or allowed to react to a warm surface, after various sense organs had been removed. The antennae and palpi are the chief organs used by *Aëdes aegypti* in locating a host and receiving the stimuli that induce probing. In cages measuring $11 \times 11 \times 15$ ins., the eyes are not needed to find the host. The antennae function as directional distance thermoreceptors and probably as chemoreceptors as well. The palpi receive stimuli when the mosquito is on or near the skin of the host. Temperature receptors are also found on the palpi in *A. aegypti*. Females from which

the antennae have been removed are not attracted to man, and removal of both antennae and palpi nearly always abolished probing. The antennae of *Anopheles quadrimaculatus* also receive directional host stimuli from a distance. In this species, a large percentage of females probe even after the removal of both antennae and palpi. The behaviour of the mosquitos indicates that in this species the hind legs may function as sense organs (when the host is near), possibly in detecting air currents or convection currents resulting from the warmth of the host.

THURMAN (E. B.), HAEGER (J. S.) & MULRENNAN (J. A.). **The Taxonomy and Biology of** *Psorophora* (*Janthinosoma*) *johnstonii* (**Grabham, 1905**) (**Diptera : Culicidae**).—*Ann. ent. Soc. Amer.* **44** no. 1 pp. 144–157, 4 figs., 17 refs. Columbus, Ohio, 1951.

The following is based on the authors' summary. Since specimens of *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham) collected in the Florida Keys showed all the variations in size and coloration that have been found in specimens of both *P. johnstonii* and *P. coffini* D. & K. from their type localities, Jamaica and the Bahamas, respectively, *P. coffini* is here designated a synonym of *P. johnstonii*.

The typical larval habitat of *P. johnstonii* in Florida was found to be a densely shaded, shallow, rain-filled depression, although several larvae were collected in deep sunlit pools. Adults were found to bite throughout the day under sunny, cloudy, calm, windy or rainy conditions. Under local conditions, *P. johnstonii* was recognised as the chief pest mosquito. It often outnumbered *Aëdes taeniorhynchus* (Wied.), which has generally been considered the most important pest mosquito of the Florida Keys.

HUGONOT (R.). **Une épidémie de paludisme au Sahara.**—*Arch. Inst. Pasteur Algérie* **28** no. 4 pp. 469–508, 4 pls., 10 figs., 25 refs. Algiers, 1950.

A detailed account is given of the malaria situation since 1907 and of a severe outbreak that occurred in 1949 in Beni Ounif-de-Figuig, an oasis in the Algerian Sahara, which, though originally a focus of hyperendemicity, was freed of Anophelines and of the disease for several years by measures against the larvae supplemented by drug treatment of infected people. No case of malaria was seen there between 1926 and 1942, but some cases that had probably been acquired outside the oasis occurred in 1943 and 1944. Locally acquired malaria reappeared in 1945, probably because breeding places for Anophelines had been produced by relatively slight changes in water management, with more abundant irrigation of gardens and the formation of small borrow-pits, and in 1949, when rainfall was abundant following four years of drought, a large population of *Anopheles multicolor* Camb., probably the only vector involved, was able to develop. The only other species of *Anopheles* seen in 1949 was *A. hispaniola* Theo. *A. dthali* Patt. and *A. sergenti* (Theo.) have been recorded from Beni Ounif-de-Figuig in earlier years.

WALTON (G. A.). **On the Control of Malaria in Freetown, Sierra Leone. II. Control Methods and the Effects upon the Transmission of** *Plasmodium falciparum* **resulting from the reduced Abundance of** *Anopheles gambiae*.—*Ann. trop. Med. Parasit.* **43** no. 2 pp. 117–139, 20 figs., 18 refs. Liverpool, 1949.

The following is virtually the author's summary. A theoretical relationship between the infective density of *Anopheles gambiae* Giles and the infection of the blood of African infants by *Plasmodium falciparum* [*R.A.E.*, B **39** 67] is

used as a means of quantitative appraisal of malaria-rates in Freetown, Sierra Leone. Since pregnant African women in Freetown showed the same malaria incidence and seasonal changes as schoolchildren, the parasite rates in both were used tentatively to assess the amount of malaria transmission in terms of infections received during a year by the average person.

Between 1941 and 1943, preparations were made for a combined Services and civilian malaria-control campaign, and the campaign began on 1st January 1944. The organisation of Anopheline control in Freetown is briefly described. It drastically reduced the numbers of infected females of *A. gambiae*. The consequent reduction of human malaria is assessed. It is suggested that a stabilised basic state has been approached where the average Freetown resident acquires one infection every two years. It is believed that these infections are now largely derived from sources outside the city, and consequently no further improvement is anticipated. Under present conditions, one-tenth of the African population will remain constantly infected. It is shown that this reduced rate of infection has been followed by a partial loss of immunity and by increased severity of parasite infestation and symptoms. Evidence suggests that the gametocyte-rate of *Plasmodium falciparum* has remained constant, irrespective of the reductions in the parasite-rate. The reduced sporozoite-rate of *A. gambiae* was apparently due, not to changes in the incidence or infectivity of the gametocytes, but to a reduction in the mean length of life of *A. gambiae* resulting from the method of control in use. Consequently, relaxation of control may result in a rapid increase of malaria, with serious consequences. The situation achieved is beneficial to Africans only if the danger to infants and non-immune adult residents is fully realised, and if treatment for malaria is readily available.

The necessity of using larvicides in attempts to eradicate *A. gambiae* is stressed. Engineering measures are essential if the larvicides are to be fully effective, but they cannot replace them. Provided that breeding by *A. gambiae* can be confined to small isolated foci, the virtual cessation of malaria transmission can be achieved by the repeated use of pyrethrum sprays in a small number of infested houses to exterminate the localised adult Anophelines.

It is considered that reduction of malaria transmission in Freetown to 0·5 infective bites per year per person has been proved to be practicable, but that to reduce it further, the boundaries of the districts controlled would have to be extended to include a very much larger area.

Smithburn (K. C.), Goodner (K.), Dick (G. W. A.), Kitchen (S. F.) & Ross (R. W.). **Further Studies on the Distribution of Immunity to Yellow Fever in east and south-east Africa.**—*Ann. trop. Med. Parasit.* **43** no. 2 pp. 182–193, 5 maps, 3 refs. Liverpool, 1949.

The following is virtually the authors' summary. Results of yellow-fever protection tests are reported on 5,154 indigenous residents of 10 countries in Africa, 36 residents of Arabia and 221 labourers immigrant to the Union of South Africa. Immune individuals were found in every country sampled except Arabia and Swaziland. Among the countries surveyed, the incidence of immunity from yellow fever was highest in Northern Rhodesia, and within that country the incidence was greatest along the Zambesi River. The zone of infection in Africa [*cf. R.A.E.*, B **37** 94, etc.] is now known to include Lindi, on the east coast in Tanganyika, and to extend at least as far south as Tsau, in Bechuanaland, which lies just south of the 20th parallel of latitude. The implications of the results are discussed briefly with reference to the migration of labourers in southern Africa.

SWAROOP (Satya). **Forecasting of epidemic Malaria in the Punjab, India.**—*Amer. J. trop. Med.* **29** no. 1 pp. 1–17, 4 figs., 3 refs. Baltimore, Md., 1949.

The method used for nearly a quarter of a century for forecasting epidemics of malaria in the Punjab [*R.A.E.*, B **33** 170, *cf.* also **11** 115] is recapitulated, the success attained with it is assessed, and brief reference is made to investigations of ways of improving it. These were begun in 1943 and had to be terminated in 1947, when the province of the Punjab ceased to exist as a single entity owing to its division between Pakistan and the Union of India. The studies had shown that the method possessed some usefulness. It was found, however, that increased malaria was associated not only with increased rainfall in July and August, which prolongs the life of Anophelines, but also with increased rainfall in May, or in some areas, April, though the reason for this was not evident. It also appeared that there is a periodicity of about eight years' duration in the incidence of malaria and that data on spleen size do not help in forecasting epidemics.

TERZIAN (L. A.) & WEATHERSBY (A. B.). **The Action of antimalarial Drugs in Mosquitoes infected with** *Plasmodium falciparum*.—*Amer. J. trop. Med.* **29** no. 1 pp. 19–22, 3 refs. Baltimore, Md., 1949.

As defined for the purposes of this study, a drug is prophylactic in the vertebrate host if, when administered for a specific interval, it permanently interrupts the pre-erythrocytic development of the malaria parasite and prevents the formation of the erythrocytic forms, and a drug is prophylactic in the mosquito if it is effective against the pre-sporozoite stages of the parasite and prevents the formation of sporozoites. On this basis, it is possible to make valid comparisons of the related prophylactic activity in the two hosts. Experiments with *Plasmodium gallinaceum* have shown that drugs that have a prophylactic effect on sporozoite-induced infections in the vertebrate host have a similar effect in *Aëdes aegypti* (L.) in that they permanently arrest oöcyst development if the mosquitos are fed on sugar solution containing them, whereas ordinary suppressive drugs that have no prophylactic activity in the vertebrate host are similarly ineffective in the mosquito. Verification of the results of mosquito dissection by inoculation of ground suspensions of whole mosquitos into susceptible chicks showed that the two methods were invariably in agreement, and consequently that the confirmation of findings by inoculation is unnecessary.

In studies with laboratory strains of *Anopheles quadrimaculatus* Say infected with *Plasmodium falciparum* and subsequently fed on sugar solution in which the drugs had been incorporated, four drugs curative but not prophylactic against *P. falciparum* in man (including sodium sulphadiazine) had no effect on the production of sporozoites or on the sporozoites themselves, but neither oöcysts nor sporozoites could be found in mosquitos that received paludrine (a prophylactic in the vertebrate host) and were dissected after six days. Dissection on the fourth day revealed a few tiny oöcysts [*cf. R.A.E.*, B **39** 99]. Although paludrine was also prophylactic for *P. gallinaceum*, oöcysts of this species persisted in *Aëdes aegypti* for as long as 30 days, before deteriorating. Sodium sulphadiazine, which is prophylactic for *P. gallinaceum* in the vertebrate host, is also prophylactic for it in the mosquito. Thus, the results obtained again reveal a specific relation between the effects in vertebrate and invertebrate host.

Bustos Castellanos (J.), Cerdán Murrieta (L.), Lassman (G.) & Ortiz (C.). **A Malaria Reconnaissance of the State of Veracruz, Mexico.**—*Amer. J. trop. Med.* **29** no. 1 pp. 23–35, 6 maps. Baltimore, Md., 1949.

The following is based on the authors' summary. A malaria reconnaissance of the State of Veracruz, Mexico, was carried out in 1944–46 inclusive. The zone as a whole can be characterised as one of moderate endemicity. Evidence is given to show that the areas with an altitude of less than about 3,000 ft. are the most favourable for transmission. *Plasmodium vivax* is more plentiful than *P. falciparum* at all levels, and its predominance increases with altitude. Twelve species of *Anopheles* were found. *A. albimanus* Wied., *A. pseudopunctipennis* Theo. and *A. quadrimaculatus* Say are probably the most important species in the transmission of malaria, but adequate studies for the determination of the vectors have not been made.

Wood (S. F.). **Additional Observations on *Trypanosoma cruzi* Chagas, from Arizona in Insects, Rodents, and experimentally infected Animals.**—*Amer. J. trop. Med.* **29** no. 1 pp. 43–55, 12 figs., 1 map, 13 refs. Baltimore, Md., 1949.

Previous records of natural infection of Triatomine bugs with *Trypanosoma cruzi* in Arizona [*R.A.E.*, B **24** 206 ; **32** 57 ; **35** 136] are reviewed, and new ones are given. It has now been found in five localities and in *Triatoma protracta* (Uhler), *T. p. woodi* Usinger, *T. rubida uhleri* (Neiva) and *T. longipes* Barber (including 82 out of 932 examples of these bugs examined), but was not found by the author in 55 examples of *Paratriatoma hirsuta* Barber, the only other Triatomine known to occur in Arizona.

Natural infection of white-footed mice (*Peromyscus boylii rowleyi*) and wood rats (*Neotoma albigula*) from two of the localities was detected by xenodiagnosis. Experimental infection of laboratory rodents with *T. cruzi* from four of the Arizona localities is recorded. Leishmanial development occurred in rodents receiving infection from all the sources.

Bates (M.) & de Zulueta (J.). **The seasonal Cycle of Anopheline Mosquitoes in a Pond in eastern Colombia.**—*Amer. J. trop. Med.* **29** no. 1 pp. 129–150, 11 figs., 27 refs. Baltimore, Md., 1949.

As part of a study of the biology of Anopheline mosquitos in the region of Villavicencio, Colombia, observations were made in 1946–48 on the population of two small and permanent contiguous ponds, made by damming a small stream. The larvae most commonly present were *Anopheles rangeli* Gabaldon, Cova-García & López, *A. strodei* Root and *A. triannulatus* Neiva & Pinto. *A. darlingi* Root, *A. albitarsis* Lynch Arrib., *A. argyritarsis* R.-D. and *A. pseudopunctipennis* Theo. were found occasionally. *A. darlingi*, presumably the most important vector of malaria in the region, seemed to breed throughout the year. Catches of adults in a stable trap with a donkey as bait [*R.A.E.*, B **33** 96], which was maintained at the ponds, showed peaks in June (in the rainy season) and January (in the dry season). *A. rangeli*, *A. triannulatus* and *A. strodei* represented 87, 2 and 1 per cent. of Anophelines caught in June and 34, 30 and 21 per cent. of those caught in January. Data from a trap in another locality showed that the seasonal change from a preponderance of *A. rangeli* in the wet season to one of the other species in the dry season is general for the region. Peaks in larval abundance, as determined by dipping, coincided with or slightly preceded the peaks of adult abundance. There was no indication of differential mortality among larvae of different species to account for the seasonal change in adult prevalence. Fluctuations in the percentage of larvae reaching the fourth instar were not great, though mortality tended to be highest when larval

density was greatest. The larval-instar ratio remained remarkably constant through the year, in spite of great changes in larval density and species composition. This is taken to indicate that these changes depended on events outside the aquatic habitat.

The aquatic environment was studied. Water temperature was remarkably constant through the year with a mean of about 25–26°C. [77–78·8°F.] at the surface. The proportion of soluble organic material in the water was greatly reduced with the onset of the rains, but evidence is lacking to show whether the limits of tolerance of species breeding in the ponds lay between the extremes of fluctuation. The literature on the seasonal fluctuation of Anophelines in the tropics is briefly reviewed. Present knowledge seems to be inadequate to interpret it. It is concluded that more attention should be paid to the effect of environmental factors on adult populations, as the specific limiting factors controlling distribution of Anophelines appear to operate in the adult, rather than in the larval, stage.

Sarles (M. P.), Dove (W. E.) & Moore (D. H.). **Acute Toxicity and Irritation Tests on Animals with the new Insecticide, Piperonyl Butoxide.**—*Amer. J. trop. Med.* **29** no. 1 pp. 151–166, 8 refs. Baltimore, Md., 1949.

A summary is given of the results of tests in which undiluted piperonyl butoxide and representative formulations containing it were administered to laboratory mammals by stomach-tube or were applied to their eyes and skin. Small doses of 5 per cent. emulsion were not toxic to rats and rabbits that received, respectively, 6 and 3 doses at weekly intervals. The median lethal dose of undiluted piperonyl butoxide administered by stomach-tube fell between 7·5 and 10 ml. per kg. body weight for rats and 2·5 and 5 ml. for rabbits and was apparently above 7·5 ml. for cats and dogs. The median lethal dose of a concentrate containing 20 per cent. piperonyl butoxide and 2·5 per cent. pyrethrins in base oil was above 7·5 ml. per kg. for rats and rabbits, and the concentrate seemed little if any more toxic for rats than deodorised petroleum oil alone. Piperonyl butoxide was relatively non-toxic and was not absorbed when injected subcutaneously into rats and caused no irritation when applied undiluted or in water emulsion or in oil solution with or without pyrethrins to the eye or skin of albino rabbits. Undiluted, it was mildly irritant to rabbit skin on repeated application, but at 4 per cent. in oil solutions with and without pyrethrins and in a water emulsion with pyrethrins, it was not. Neither undiluted piperonyl butoxide nor solutions containing it caused sensitisation. Tests in another laboratory showed no marked toxic effect in rats exposed for 30 minutes a day on 24 days to abnormally heavy concentrations of sprays and aerosols containing piperonyl butoxide and pyrethrins.

It is concluded that the practical use of piperonyl butoxide induces no appreciable risk of poisoning or irritation and that it is one of the safest and least toxic of insecticides.

Hurlbut (H. S.) & Thomas (J. I.). **Potential Vectors of Japanese Encephalitis in the Caroline Islands.**—*Amer. J. trop. Med.* **29** no. 2 pp. 215–217, 5 refs. Baltimore, Md., 1949.

Japanese B encephalitis has recently been found to occur on Guam and is probably present on other tropical islands in the Pacific. In view of this, experiments were made to determine whether two man-biting mosquitos from Ponape in the Eastern Caroline Islands, *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) and *C. annulirostris* Skuse, could transmit the virus to mice. They were fed on an emulsion of infected mouse brain and after an incubation period of 6–8 days at 30°C. [86°F.] were allowed to bite suckling mice. These

developed typical symptoms of encephalitis, and their brains were shown to contain the virus of Japanese B encephalitis in high titre by passage and, in the case of those infected by *C. annulirostris*, by neutralisation tests also.

Scaffidi (V.). **Il tifo esantematico di genesi murina.** [Typhus of Murine Origin.]—7+[2+] 216 [+1] pp., 42 figs., 3 fldg. maps, 25 pp. refs. Naples, V. Idelson, 1951. Price *L.* 1500.

This book, which is based on the literature and the author's own experience in Africa and Italy, is divided into two main parts. The first deals with the normal benign form of murine typhus and contains accounts of the properties of the rickettsia that causes it, its relation to classical typhus transmitted by lice [*Pediculus humanus humanus* L.], its transmission among rats by *Xenopsylla cheopis* (Roths.) and by other ectoparasites, and its epidemiology in man, including its world distribution, the relation of human cases to the rat enzootic, the fleas, chiefly *X. cheopis*, that transmit it to man, the seasonal occurrence of cases and their course, and notes on prophylaxis and clinical characters. The second part comprises discussions of epidemic louse-borne typhus of murine origin, which is known from Mexico, Manchuria, Spain, Uganda and Nigeria, Brill's disease, which was at one time considered to be a form of typhus of murine origin but is now recognised as a form of classical typhus, and the differences between murine typhus and the rickettsial diseases that are transmitted by ticks and Trombiculids. The author's conclusions are set out in a short final section. He considers that murine typhus is a disease that is enzootic and at times epizootic in rats, among which it is transmitted by the faeces of infected fleas, and that it is accidentally transmitted in the same way to man, in whom it is characterised by its mild character, the absence of complications, and low mortality (1–5 per cent.). It is thus distinct from classical louse-borne typhus, but each may at times acquire characters typical of the other, so that control of lice is warranted whenever cases of murine typhus occur among persons infested by lice.

Weyer (F.) & Zumpt (F.). **Grundriss der medizinischen Entomologie, mit Einschluss der übrigen medizinisch wichtigen Gliederfüssler.** [An Outline of medical Entomology, including other Arthropods of medical Importance.]—3rd revd. edn., $9\frac{1}{4}\times6\frac{1}{4}$ ins., vi+150 pp., 66 figs., 23 refs. Leipzig, J. A. Barth, 1952. Price *DM.* 7.50.

The third edition of this handbook resembles the second in scope [*R.A.E.*, B **37** 194], but has been somewhat enlarged. A table showing the diseases of man and animals that are transmitted by ticks, with their vectors, hosts and geographical distribution, has been added, and the section on control has been rewritten and brought up to date by the inclusion of insecticides developed more recently than DDT.

Gansser (A.). **Dasselfliegen. Biologie, Schäden und Bekämpfung von Oestriden mit besonderer Berücksichtigung schweizerischer Verhältnisse.** [Warble-flies. The Biology and Control of Oestrids and the Harm they cause, with special Reference to Swiss Conditions.]—128 pp., 1 col. pl., 62 figs., 62 refs. Zürich, Schweiz. Häuteschädenkomm., 1951. (Obtainable from Buchdruckerei zum Hirzen AG., Basle.) Price *Fr.* 9.50.

This booklet is a revised and expanded version of a paper that originally appeared in 1923 [*R.A.E.*, B **12** 11], and though it has special reference to conditions in Switzerland, much of the matter is of wider interest. It deals very largely with *Hypoderma bovis* (Deg.) and *H. lineatum* (Vill.) on cattle, but includes information on other Oestrids that attack domestic and wild

animals in Switzerland or elsewhere. Summaries in French are appended to most of the sections.

The first section contains a general account of the bionomics of *H. bovis* and *H. lineatum*, including the migration of the larvae in the body of the host, and this is followed by more detailed studies of the morphology and biology of the individual stages, including each of the five larval instars, descriptions of the warbles, and notes on characters by which the larvae of the two species can be distinguished, with information on local frequency in Switzerland. Oviposition, which is described, does not appear to be limited in that country to any one part of the body, and the adult flies appear to assemble year after year in particular localised habitats for pairing. Reference is also made to the occasional infestation of man and horses by *Hypoderma*, and to warble-flies that attack wild animals. Further sections contain short accounts of *Gasterophilus* spp. in horses and of various Oestrids that infest the head cavities of animals, including *Oestrus ovis* L. in sheep.

The damage to hides caused by *Hypoderma* spp. and the effect of infestation on the condition of the cattle are described, and their control is discussed at some length. Squeezing the larvae out of the warbles or killing them in them with stiff brushes is effective, but chemical control is now more generally used. Preparations of nicotine or derris are very efficacious, and one containing nicotine (Hypocotin) and three containing derris (Antassin, Tikizid and Varotox) are officially recommended in Switzerland. They are mixed with water and rubbed into the warbles by hand, and detailed instructions for their use are included. Preventive measures, the natural enemies of *Hypoderma* (which include a parasite of the genus *Alysia* in Switzerland, but are not of importance), and the possibility of a periodicity in the intensity of attack are briefly discussed.

The control of *Hypoderma* has been officially organised in Switzerland since 1921 and obligatory since 1944, and the regulations and recommendations relating to it are reproduced in appendices.

Papers noticed by Title only.

Harvey (G. T.) & Brown (A. W. A.). **The Effect of Insecticides on the Rate of Oxygen Consumption in** *Blattella*.—*Canad. J. Zool.* **29** no. 1 pp. 42–53, 8 graphs, 14 refs. Ottawa, 1951. [See *R.A.E.*, A **40** 160.]

Orser (W. B.) & Brown (A. W. A.). **The Effect of Insecticides on the Heartbeat of** *Periplaneta*.—*Canad. J. Zool.* **29** no. 1 pp. 54–64, 5 graphs, 9 refs. Ottawa, 1951. [See *R.A.E.*, A **40** 160.]

Vincent (D.), Truhaut (R.) & Abadie (A.). **Contribution à l'étude du mécanisme de l'action toxique de l'insecticide D.D.T. D.D.T. et systèmes cholinestérasiques chez les animaux supérieurs et les insectes.**—*C.R. Soc. Biol.* **142** no. 23–24 pp. 1500–1502, 3 refs. Paris, 1949. [See *R.A.E.*, A **40** 147.]

Wirth (W. W.). **The Genus** *Culicoides* **in Alaska (Diptera, Heleidae).**—*Ann. ent. Soc. Amer.* **44** no. 1 pp. 75–86, 26 figs., 8 refs. Columbus, Ohio, 1951.

Liste officielle des noms français des insectes d'importance économique au Canada [including French, English and scientific names]. **(Préparée par le Comité permanent des noms français de la Société de Québec pour la Protection des Plantes. Publiée en supplément du rapport annuel de cette Société pour l'année 1951.)**—2nd edn., 73 pp. Quebec, Minist. Agric., 1952. [*Cf. R.A.E.*, B **37** 164.]

TUXEN (S. L.). **The Harvest Mite, *Leptus autumnalis*, in Denmark. Observations made in 1949.**—*Ent. Medd.* **25** pt. 6 pp. 366–383, 11 figs., 7 refs. Copenhagen, 1950.

Trombicula (*Leptus*) *autumnalis* Shaw has been known as a serious pest in the town of Thisted, in western Jutland, since 1874 and has spread to a few villages on its outskirts since 1900. It is not known elsewhere in Denmark, and this is apparently its northern limit in Europe. The town is on chalk soil and contains numerous gardens, which are so heavily infested by the larvae in July-September that the inhabitants cannot cross them without being attacked. The mites have also been found on domestic animals, rodents and birds [*cf. R.A.E.*, B **25** 220]. During investigations in 1949, the author found that a rough indication of local infestation could be obtained by counting the mites that gathered on his shoes after he had walked slowly for one minute on a lawn. Tests made in this manner throughout the 24 hours showed that the mites were more numerous on shady lawns than on open ones and most numerous just before dusk. This seemed to be due to a preference for high humidity.

In tests of repellents, 30 per cent. dibutyl phthalate in alcohol rubbed on the legs, arms and neck every morning proved completely effective, but a similar solution of dimethyl phthalate sometimes failed [*cf.* **37** 74–75]. When several hundred mites were swept on to filter papers soaked in the two liquids, they were rapidly repelled by the dibutyl phthalate but immobilised and killed by the dimethyl phthalate, possibly owing to its more rapid penetration into them. Experiments were also carried out on methods of eradicating the mites from the gardens without causing excessive mortality of soil microfauna. Spraying gardens with a concentrate containing 4 per cent. azobenzene in a mixture of trichloroethylene, methyl cellulose and water diluted to 1 per cent. in June, when it was thought the eggs might be present, had no effect, but a concentrate containing 2·7 per cent. benzene hexachloride, 4 per cent. azobenzene and 0·3 per cent. parathion in the same mixture, applied at 1 or 0·5 per cent. to 23 gardens in mid-August, proved effective, very few or no mites being found in them in late August and early September, when there were still many in untreated gardens. The two dilutions gave equally good results. There was a considerable reduction in soil arthropods, particularly those in the upper layers. A note on the chaetotaxy of the larval mites is appended.

OLSON (T. A.) & RUEGER (M. E.). **Experimental Transmission of *Salmonella oranienburg* through Cockroaches.**—*Publ. Hlth Rep.* **65** no. 16 pp. 531–540, 3 refs. Washington, D. C., 1950.

An account is given of the technique and results of experiments on the possible relation of cockroaches to *Salmonella oranienburg*, which is commonly associated with outbreaks of food poisoning in the United States and Canada [*cf. R.A.E.*, B **38** 15]. It was recovered from the faeces of *Periplaneta americana* L., *Blattella germanica* L. and *Blatta orientalis* L. up to 10, 12 and 20 days, respectively, after a single infective meal, and infected faeces were usually produced within 24 hours. An individual of *B. orientalis* was still positive when killed 42 days after the infective feed, though it had passed contaminated faeces only during the first 20 days. Feeding tests with carmine and acriflavine showed that about six days are needed for mechanical clearing of the digestive system of *P. americana*. The *Salmonella* survived in faecal pellets of *P. americana* for 199 days at room temperature with a relative humidity of 31 per cent. or slightly less and for 85 days at 52–56 per cent. relative humidity. Organisms

from a culture of it survived for 34 days on glass, 88 days on soda biscuits, 62 days on corn flakes and 78 days on the relatively smooth pronotum of the cockroach. The cockroaches contaminated watering tubes by mouth contact or regurgitation at least four days after the infective feeding, and the *Salmonella* survived on the cotton wick of the watering device for 15 days.

DALMAT (H. T.). **Induced Oviposition of *Simulium* Flies by Exposure to CO_2.**—*Publ. Hlth Rep.* **65** no. 16 pp. 545–546. Washington, D. C., 1950.

At a field laboratory in Guatemala, attempts to establish a colony of *Simulium* spp. in a large outdoor screen cage over a cement channel through which a stream had been diverted were begun in 1948. Plants found in the natural habitats of the Simuliids were grown in the cage, two species on which the females commonly oviposit being so placed that their leaves floated on the stream, and natural conditions of temperature and humidity, light and shade were simulated as nearly as possible. Opportunity to feed on man was given, and defibrinated human blood, blood plasma, honey and sugar solutions and plant juices were also available. Small numbers of the adults lived up to 18 days, but none oviposited until 1950, when they were treated with carbon dioxide before being released in the cage. They were placed in a jar into which the gas was introduced through a tube until all were immobilised. The jar was then left open until they had revived ; the whole process of treatment and recovery required about four minutes. The treatment appeared to have an immediate effect on behaviour ; a few of the adults mated, and many females assumed a position as though they were biting. On being released in the large cage, some took a blood-meal and several of those that had fed also oviposited within 4–6 hours. Trials have been made with 982 individuals of *S. ochraceum* Wlk., 1,112 of *S. metallicum* Bellardi and 438 of *S. callidum* D. & S. Of these, 84 have taken blood-meals, and 21 females of *S. metallicum* and 11 of *S. callidum* have oviposited. None of the eggs has developed. Reasons for this are suggested. Experiments are to be made with different dosages of carbon dioxide to preclude possible deleterious effects of overtreatment. In spite of the failure of the eggs to develop, the results so far obtained are considered encouraging as this is the first reported instance of induced egg-laying in captivity by Simuliids.

FIEDLER (O. G. H.). **Der Feldzug gegen die Tsetsefliege im Zululand.** [The Campaign against the Tsetse Fly in Zululand.]—*Z. angew. Ent.* **31** pt. 4 pp. 509–536, 9 figs., 7 refs. Berlin, 1950.

Only three species of *Glossina* have been present in Zululand since the beginning of the century, *G. pallidipes* Aust., which is the commonest, *G. brevipalpis* Newst., and *G. austeni* Newst., all of which transmit trypanosomiasis of cattle. The climate and topography of the area, which includes the Umfolosi, Hluhluwe and Mkusi game reserves, and the history of the infestation are reviewed. Tsetses and cattle trypanosomiasis occurred throughout northern Zululand in 1915, and though a campaign against game subsequently led to a reduction, the flies again spread over large areas in 1927 and 1930, their density being particularly high in the three reserves. Attempts to control them by means of Harris traps were begun in 1931, and were at first apparently very successful, the numbers of tsetses caught per trap in Umfolosi falling from 2,700 a month to a minimum of 0·04 in 1938 [*cf. R.A.E.*, B **28** 76, etc.]. The flies became rare even in the reserves and trypanosomiasis of cattle disappeared from settlements and native areas. The tsetses began to increase again in mid-1938, however, in spite of the use of large numbers of traps, and it appeared that the use of the latter had been begun at the peak of an outbreak and that the fall in

population was due not to them but to a natural decline. The increase continued at an even greater rate, until in 1944–45 an epizootic of trypanosomiasis occurred that led to the loss of 60 per cent. of cattle. Infestation occurred not only in the vicinity of the reserves but spread to fresh areas, such as Ngotshe [**39** 34]. In view of the seriousness of the situation, it was decided to attempt control by means of insecticides.

Surveys of the *Glossina* populations were made as a preliminary. Harris traps and live animals were used, and pupal surveys were made. The resulting distribution of each species is shown on a map. *G. pallidipes* was the most widely distributed and was found in 75 per cent. of the total infested area. It thrives in the savannah and its chief breeding grounds were the three reserves. Three types of haunts are distinguished, the permanent breeding grounds, secondary breeding grounds, in which breeding was slowly extending, and dispersion areas, where the flies sought food but did not breed, either because of unsuitable ecological conditions or because they had invaded them too recently to become established. The numbers of adults of *G. pallidipes* were subject to seasonal fluctuations. In the permanent breeding grounds, they fell to a minimum in midsummer (February–March), increased until May and, after falling slightly, reached a maximum in early spring (August–September). In the dispersion areas, the flies were most numerous in summer. Very high numbers were sometimes found in the secondary breeding grounds. The average times required for the development of pupae kept under natural conditions were 35 days in summer (December–January) and 110 days in winter.

G. brevipalpis was found only in thickly wooded country. It rarely left its breeding grounds and consequently came into little contact with cattle grazing in the savannah. Its numbers varied in the same way as those of *G. pallidipes*, and the pupal period was also extended during the winter to up to 100 days. *G. austeni* was frequently inconspicuous, but was widely distributed in the coastal region and rapidly extended its habitat under suitable conditions. Its density often varied at a given time in apparently similar localities. It preferred high humidity and shade, and bred in thick impenetrable bush, usually in connection with open water. The length of the pupal stage was not ascertained.

A preliminary control experiment was begun in December 1945 in the Mkusi reserve, where there was little danger of reinfestation from outside. An emulsion spray containing 5 per cent. p,p′DDT was applied three times at intervals of 14 and 21 days from aeroplanes at a rate giving about 0·65 lb. p,p′DDT per acre. As a consequence, the weekly catch of flies fell from 8,000 to about 1,000. The failure to obtain better control was due to deposition of DDT on the upper surfaces of the leaves so that it did not penetrate to the resting places of the flies beneath the foliage. A series of aerosol treatments was therefore begun in August 1946. The aerosol was released from a solution of 16 per cent. DDT in toluene and diesel oil from aeroplanes at a rate giving nearly 0·3 lb. p,p′DDT per acre, and eight applications at fortnightly intervals were made. This reduced the weekly numbers of flies caught from 1,400 in August to 5–6 in December. There was a slight increase in mid-1947, and a further series of eight treatments was applied, at intervals of 3–4 weeks, which proved very suitable. This series ended in September, and no examples of *G. pallidipes* were taken in the area after July. This situation continued at the time of writing.

Application of aerosols was extended to the other reserves during 1947 and to the farm areas in Ngotshe and gave equally good results. No tsetses were taken after September 1949 in Umfolosi or Ngotshe, where the species concerned was *G. pallidipes*, but small numbers of *G. pallidipes* and *G. brevipalpis* persisted in Hluhluwe and required further treatment. In narrow valleys impenetrable

by normal aircraft, small dusting appliances and smoke generators containing DDT were used. During the later years of the campaign, the aerosols were distributed from helicopters, and benzene hexachloride was substituted for DDT, since it was initially more toxic and the persistent effect of the DDT was negligible at the low concentrations employed. Treatment was supplemented outside the reserves by adding DDT to the normal cattle dips and dipping cattle weekly. No cases of cattle trypanosomiasis occurred in the Mkusi area after the disappearance of *G. pallidipes*. The work as a whole showed that *G. austeni*, which was difficult to control owing to the remoteness of its breeding grounds, was of little importance in the spread of trypanosomiasis, and that blood-sucking flies other than *Glossina*, though capable of spreading infection within a herd [*cf.* **22** 74], were incapable of spreading it from game to domestic animals.

HARRISON (R. A.). **The Occurrence in New Zealand of Houseflies resistant to D.D.T.**—*N.Z. J. Sci. Tech.* **32** (B) no. 5 pp. 40–43, 5 refs. Wellington, N. Z., 1951.

In New Zealand, there was some indication in 1948 that DDT was not effecting as good control of house-flies [*Musca domestica* L.] as in previous years, and reports of failure in widely separated areas were numerous from February 1949. During February and March, flies were collected in DDT-treated premises at six places in the Auckland area, and six lines, designated B–G, were bred from them. The original flies showed no abnormal mortality immediately after capture, though many were in contact with DDT deposits when netted. When flies of line D were exposed for 3½ hours to DDT deposits of 200 mg. per sq. ft. on the painted walls of test boxes, and then kept in clean cages, knockdown in 2 hours and mortality after 24 hours were 6·8 and 27·2 per cent., as compared with 52·1 and 79·2 per cent. for flies of a laboratory line (A) not previously exposed to DDT. In tests with flies of the 3rd–5th generations exposed for various periods up to 32 minutes, all the six lines showed less mortality with almost all exposures than did the laboratory flies. With exposure for 4 mins., the percentages dead after 24 hours (with percentages for controls in brackets) were 45 (85), 60 (72·5), 30 (87·5), 22·3 (87·5), 13·3 (82·5) and 5 (75) for fifth-generation flies of line B, fourth-generation flies of lines C, D and E and third-generation flies of lines F and G, respectively. With exposure for 16 mins., the corresponding figures were 97·5 (100), 95 (100), 97·5 (100), 100 (100), 65 (97·5) and 15·4 (95).

BUCK (J. B.) & KEISTER (M. L.). **Respiration and Water Loss in the Adult Blowfly, *Phormia regina*, and their Relation to the physiological Action of DDT.**—*Biol. Bull.* **97** no. 1 pp. 64–81, 9 figs., 14 refs. Lancaster, Pa., 1949.

The following is substantially the authors' summary of the results of observations on the weight, oxygen uptake and behaviour under very humid and very dry conditions of normal adults of *Phormia regina* (Mg.) and others poisoned by exposure for 10–15 minutes to a heavy DDT deposit. The flies of the four groups are referred to as wet normal, dry normal, wet DDT and dry DDT flies. Loss of live weight was roughly linear over at least the first ten hours. It was greatest in dry DDT flies, greater in wet DDT than in dry normal flies, and smallest in wet normal ones. Water formed about 60 per cent. of total weight loss in wet DDT flies and 80–90 per cent. in the other groups and was probably lost almost entirely by spiracular transpiration. Metabolic water loss calculated

from total oxygen uptakes was in reasonably good agreement with that calculated from dry weight loss. It is concluded that both DDT and a dry atmosphere enhance water loss, that DDT enhances loss of both metabolic and reserve water and that loss of water is not the primary cause of death in DDT poisoning.

DDT induced an average five-fold increase in oxygen uptake of wet flies. Individuals reached transient peaks of 15–20 times the control rate, associated with a violent wing buzzing. The increase was significantly smaller in dry flies. After ten hours, dry weights were greatest among normal flies and greater in dry DDT than in wet DDT flies. At death, they were greatest in dry DDT flies, greater in dry normal than in wet DDT flies and least in wet normal flies. It is therefore concluded that death is not primarily due to exhaustion of respirable substrate, on the assumption that the DDT and normal flies use the same materials. This conclusion is also supported by the fact that a heavier, more toxic dose of DDT produced a smaller increase in oxygen uptake than did a lighter. Over a period of ten hours, total oxygen uptake was proportional to both live and dry weight losses in the DDT flies. In the wet DDT flies, relative solid content remained approximately constant, and respirable substrate decreased at a higher rate than did water. The estimated respiratory quotients were about 0·90 in normal flies and 0·96 in DDT flies. Oxygen became limiting to the enhanced uptake, and to hyperactivity, at a tension of about 90 mm. Active normal flies reached rates of oxygen uptake comparable to those of DDT flies. Overt activity showed a rough correlation with rate of oxygen uptake. Several parallels between metabolism in normal flight and physiological manifestations of DDT poisoning are pointed out. It is concluded that the increased oxygen uptake in DDT poisoning is due to the motor hyperactivity induced. No ammonia production was found in either normal or DDT flies. Hydrogen-ion determinations on breis of normal and DDT flies indicated that no general acidosis occurred during DDT poisoning. The parts played by dosage, age and narcosis in producing variability in the results are discussed.

Sailer (R. I.) & Lienk (S. E.). **Blow Flies (Calliphoridae) in Alaska.**—*Canad. Ent.* **83** no. 8 pp. 208–211, 3 refs. Ottawa, 1951.

Eight species of Calliphorids were taken in Alaska in 1948 in traps containing liver or dead salmon as bait. The traps were in operation between 28th May and 14th June at one place and in mid-August at another. Much the most numerous species, the only one taken in all collections and the one most likely to have significance in public health was *Phormia* (*Protophormia*) *terraenovae* R.-D., which was abundant throughout the trapping season. It is known to produce wound myiasis in domestic animals, including reindeer in Alaska [*cf. R.A.E.*, B **11** 120], and to oviposit on fresh meat and otherwise contaminate human food. Adults collected in the field in the United States have been found to be infected with poliomyelitis virus. *Lucilia illustris* (Mg.) and *Calliphora terraenovae* Macq. were the next most numerous species, but neither was taken before 14th June. They are not known to have significance in public health in the United States and probably have little in Alaska. A list with distributional records is given of the 18 Calliphorids known in Alaska, based on the published information and the collection of the United States National Museum.

Pankaskie (J. E.), Fountaine (F. C.) & Dahm (P. A.). **The Degradation and Detoxication of Parathion in Dairy Cows.**—*J. econ. Ent.* **45** no. 1 pp. 51–60, 31 refs. Menasha, Wis., 1952.

In the first of two further experiments [*cf. R.A.E.*, B **40** 25], five cows in mid-lactation ingested parathion with their food at an average daily rate of

0·33 mg. per kg. body weight for 61 days, and no adverse effect on their milk production, weight or general health was observed. Throughout the experiment, no parathion or free p-nitrophenol was found in samples of their milk, jugular blood or urine, and no free p-aminophenol in their urine. In the second experiment, parathion as a commercial wettable powder was fed in capsules to a cow at rates increasing from 1 to 32 mg. parathion per kg. body weight per day over a period of 14 weeks. Examination of samples of its milk, blood and urine again showed no parathion, free p-nitrophenol or free p-aminophenol and indicated that the parathion must be hydrolysed *in vivo* to p-nitrophenol, reduced to p-aminophenol, conjugated with glucuronic acid to an appreciable extent and then excreted in the urine as p-aminophenylglucuronide. The fate of the thiophosphoric acid portion of the parathion molecule was not determined.

Barrett jr. (W. L.). **Control of House Flies with Methoxychlor in Texas Dairy Barns.**—*J. econ. Ent.* **45** no. 1 pp. 90–93, 9 refs. Menasha, Wis., 1952.

An account is given of tests carried out in southern Texas in 1950 on the causes of variation in the duration of effective control of house-flies [*Musca domestica* L.] in dairy barns following the application of deposits of methoxy-DDT (methoxychlor). All interior surfaces except the inside of feeding troughs in two screened and 13 unscreened barns were sprayed once between 27th April and 18th May to the point of run-off with a water suspension of 50 per cent. methoxy-DDT wettable powder used at 2 lb. active ingredient to 12·5 U.S. gals. water. The estimated deposit was 1 mg. per sq. in. None of the barns had been sprayed with a lasting insecticide earlier in 1950. Methoxy-DDT had been used in the two previous years in the screened barns only.

Insecticidal activity as measured by the knockdown rates of flies confined in small cages on treated walls did not diminish in unscreened barns in the observation period of 6–8 weeks. The spray provided control for at least 5–7 weeks in the screened barns and in unscreened barns surrounded by premises on which good sanitation prevented development of larvae. A major cause of earlier failure in unscreened barns in areas of poor sanitation was masking of deposits with fly excrement on favoured resting places. Knockdown time for some flies in the screened barns increased considerably over the period of seven weeks probably because of resistance acquired in previous years. However, practical control did not appear to be affected. In the seventh week, when fly counts reached a level at which re-spraying was deemed advisable, many flies showed typical signs of poisoning indicating that the deposits were still active. Conditions round the screened barns were very favourable for development of larvae, but screening, in addition to reducing the number of flies entering the barns, retarded their escape and so increased the chance of their obtaining a lethal dose.

Miller (A. C.), Pellegrini jr. (J. P.), Pozefsky (A.) & Tomlinson (J. R.). **Synergistic Action of Piperonyl Butoxide Fractions and Observations refuting a Pyrethrins-butoxide Complex.**—*J. econ. Ent.* **45** no. 1 pp. 94–97, 1 fig., 7 refs. Menasha, Wis., 1952.

Technical piperonyl butoxide containing 90 per cent. by weight piperonyl butoxide was divided into fractions of which the boiling points at 0·6 mm. pressure, the percentage of the total weight, the refractive index at 20°C., the specific gravity and percentage piperonyl butoxide by weight are given. Oil sprays containing 0·06 per cent. pyrethrins with or without 0·045 per cent. of the various fractions were tested against flies [*Musca domestica* L.] to evaluate the synergistic action of the latter. One fraction containing only 15 per cent.

piperonyl butoxide had no effect when tested with pyrethrins. Others containing 76 per cent. or more increased the effectiveness of pyrethrins considerably, the five containing 97–100 per cent. being apparently the best and almost equal to one another. Cryoscopic and infra-red spectral studies on mixtures of purified pyrethrins and a composite of these five fractions gave no evidence for the formation of a molecular complex [*cf. R.A.E.*, B **38** 36] in hydrocarbon solutions.

Goodwin (W. J.), Sloan (M. J.) & Schwardt (H. H.). **Repellency Test for Horse Flies and Horn Flies in New York State.**—*J. econ. Ent.* **45** no. 1 pp. 121–122, 2 refs. Menasha, Wis., 1952.

The results of tests in 1950 on the comparative value of repellents for Tabanids (predominantly *Tabanus quinquevittatus* Wied.) and *Siphona irritans* (L.) on cattle in New York are given in tables. The spray ingredients, in descending order of effectiveness, were emulsifiable Pyrenone [a concentrate believed to contain 1 per cent. pyrethrins and 10 per cent. piperonyl butoxide], butoxypolypropylene glycol alone and with pyrethrum oleoresin [*cf. R.A.E.*, B **39** 137], and a mixture of lindane [at least 99 per cent. γ benzene hexachloride] and bentonite-sulphur. A dust of allethrin [the synthetic allyl homologue of cinerin I] was less effective than any of the sprays, and only about half as effective as those containing Pyrenone. Tests in 1951 were accordingly directed to finding the best dilution of Pyrenone for the control of each. The spray was applied at about 1 U.S. quart per animal and a pressure of 200 lb. Dilutions of 1 : 5, 1 : 10 and 1 : 15 gave 78, 56 and 87 per cent. reduction, respectively, of Tabanids on test cattle in one locality and 8, 8 and 75 per cent. in another, the reductions being estimated from the total numbers on one side of treated and control cattle one, three and five days after treatment. In the case of the two very poor results, counts on the control cattle were low owing to adverse weather conditions. There was no marked difference between the effectiveness of the three dilutions against *S. irritans*, and percentage reduction was never less than 90.

Goodwin (W. J.) & Schwardt (H. H.). **Control of the Cattle Mange Mite.**—*J. econ. Ent.* **45** no. 1 pp. 122–124, 2 refs. Menasha, Wis., 1952.

Chorioptes bovis (Gerl.) was the most abundant mange mite on dairy cattle in New York in 1950–51. In control tests, 506 animals in 21 herds were sprayed twice at intervals of 7–11 days with suspensions applied at 400 lb. pressure and 1·5–2 U.S. gals. per animal. The materials used and the quantities per 100 U.S. gals. were 10 lb. 70 per cent. sulphur paste, 10 lb. wettable sulphur, 24 oz. lindane [containing at least 99 per cent. γ benzene hexachloride], and a mixture of 8 oz. lindane and 6 lb. bentonite-sulphur, all of which were effective in some of the tests, 4 lb. 50 per cent. technical p-chlorophenyl phenyl sulphone, which did not give lasting control, and a mixture of 24 oz. lindane and 10 lb. wettable sulphur, which gave complete control throughout the winter in all of the four tests in which it was used. Either lindane or wettable sulphur alone appeared less effective than the combination. Lindane would be preferable to wettable sulphur, as it controls all species of cattle lice present as well as mange mites.

List (G. M.). **Persistence of DDT on a treated Surface as shown by House Fly Knockdown and Kill.**—*J. econ. Ent.* **45** no. 1 pp. 127–129, 8 refs. Menasha, Wis., 1952.

The literature on the development of resistance to DDT in house-flies (*Musca domestica* L.) is very briefly reviewed. Deposits insufficient for satisfactory

control may be important in selecting resistant individuals of many species of insects. The results are therefore given of observations made over a period of years on flies in a milking barn in Colorado treated once only in August 1944 with 5 per cent. DDT in kerosene at 1 U.S. gal. per 1,000 sq. ft. Control of house-flies and *Siphona irritans* (L.) was excellent during the late summer and autumn of that year. No records were taken of other species. Kill in 1945 appeared to be equal to that in 1944. One evening in September 1945, flies were watched falling from the effects of DDT. A sample comprising 1,433 Diptera and a few other insects, collected from the floor and window sills next morning (when no living insects were seen), included 143 individuals of *M. domestica*, 101 of *Fannia canicularis* (L.), 174 of *Siphona irritans* and 830 of *Leptocera* spp. During 1946, a very large percentage of all Diptera remaining in the barn after the evening milking had died by morning, and knockdown continued to be very noticeable during 1947. Of 100 laboratory-reared house-flies caged on the ceiling of the barn on 3rd October 1947, 30 were dead after two hours, all were down after five hours and all were dead after 20 hours. At this time, all of the controls, which were separated from the ceiling by wrapping paper, were alive. The knockdown and mortality of the caged flies in similar tests made in 1948, 1949 and 1951 are shown in a table. After seven years, there was still a definite lethal effect, nearly all house-flies dying in about 20 hours and all in 24 or 40 hours. House-flies reared from wild flies from a dairy barn where DDT had been used freely from 1944 to 1947 showed some resistance, only 88 per cent. being down after 24 hours and 96 per cent. after 40 hours. In one test with *Muscina stabulans* (Fall.), 92 per cent. were down in 40 hours. The DDT was less persistent where exposed to the light and air above south and east windows.

Goodhue (L. D.) & Tissol (C. L.). **Determining the Repellent Action of Chemicals to the American Cockroach.**—*J. econ. Ent.* **45** no. 1 pp. 133–134, 1 ref. Menasha, Wis., 1952.

A method is described whereby the repellency or attractiveness of substances for cockroaches is compared by depositing them on the inside of carton shelters, which are put in large cages containing the cockroaches in a lighted room. The light drives the cockroaches to seek a shelter and they choose the least repellent to them. Over 200 chemicals were tried in preliminary tests against *Periplaneta americana* (L.), and most showed little or no effect. Those that were repellent were tested against each other in various combinations. The most effective were the butadiene-furfural copolymer, 2,3,4,5-bis(Δ^2-butenylene)-tetrahydrofurfural, and cumene isopropyl peroxide. A further investigation of other peroxides and hydroperoxides was then made, and nearly all were found to be repellent. The butadiene-furfural copolymer is a high boiling compound with little odour and is stable over long periods. In a practical test in a photographic dark room infested with cockroaches, it kept them away for more than six weeks.

Incho (E. J.). **Ratios of Piperonyl Butoxide and Pyrethrins for German Cockroach Control.**—*Soap & sanit. Chem.* **28** no. 2 pp. 142–143, 1 graph, 10 refs. New York, N.Y., 1952.

Tests on the comparative effectiveness against *Blattella germanica* (L.) of pyrethrins and piperonyl butoxide combined in different ratios, and of pyrethrins alone, made by a method already noticed [*R.A.E.*, B **37** 101], showed that ratios of 1 : 10, 1 : 8 and 1 : 5 as oil-based sprays and 1 : 10 in emulsion form were about equally effective on the basis of the concentration of pyrethrins needed to give 80 per cent. mortality after 48 hours, and were about 1·5 times

as effective as pyrethrins alone. The ratio of 1 : 2·5 was not appreciably more effective than pyrethrins alone.

Miller (A. C.), Mallis (A.) & Sharpless (R. V.). **Aerosol Insecticides, their Evaluation against House Flies, Cockroaches.**—*Soap & sanit. Chem.* **28** no. 2 pp. 151, 153, 181 ; no. 3 pp. 143, 145, 147, 149, 7 refs. New York, N.Y., 1952.

Preliminary studies are reported on some factors to be considered in the evaluation of liquefied-gas aerosols. Several variables were tested in 1947–50 with house-flies [*Musca domestica* L.], generally in a Peet-Grady or 1,000 cu. ft. chamber by the large-group procedure as specified in the NAIDM (CSMA) test method [*R.A.E.*, B **39** 6 ; **40** 15]. A highly effective formula (including 0·4 per cent. pyrethrins, 1 per cent. piperonyl butoxide and 1 per cent. DDT) did not show great increases in knockdown and kill when the dosage was doubled or trebled, but with the less effective TOTA (0·4 per cent. pyrethrins and 2 per cent. DDT), an increase in dosage from 2 to 4·1 gm. per 1,000 cu. ft. raised knockdown after 15 mins. from 44·8 to 62·6 per cent. and test knockdown mortality [**39** 6] from 44·6 to 62·5 per cent. Increase in test temperature from 70 to 80°F. greatly increased knockdown and kill, presumably because of the greater activity of the flies at the higher temperature and the larger amount of aerosol picked up in consequence [*cf.* **34** 201]. The height from which the aerosol was discharged [*cf.* **37** 104] and the manner of discharging it had a great effect and must be controlled to obtain uniform results. Delivering the TOTA from slow or fast dispensers did not appreciably affect results in the range studied (9·2 and 13·9 gm. per 10 secs.). Increase in knockdown and mortality resulted when the number of house-flies in test groups was increased from 10 to 100 and from 100 to 500, presumably because of disturbance of the flies by one another and consequent increased activity. Tests with two formulations indicated that the standard may or may not be met according to whether test knockdown mortality or test mortality is the criterion used.

Space and direct applications of TOTA and a formula including 0·4 per cent. pyrethrins, 1 per cent. piperonyl butoxide and 1 per cent. methoxy-DDT (methoxychlor) were compared against large nymphs of the American cockroach [*Periplaneta americana* (L.)] and the oriental cockroach [*Blatta orientalis* L.] and males of the German cockroach [*Blattella germanica* (L.)]. In the space applications, the aerosol was used at 75 gm. per 1,000 cu. ft. and was discharged into the upper part of the chamber. In direct applications, which were made at 5 gm. from a height of 30 ins. on to cockroaches confined by a hoop with a diameter of 32 ins., the aerosol dispenser was provided with a shortened siphon tube so that when it was inverted to spray downwards, the opening of the tube was submerged in the liquid contents and it did not discharge gas alone. Except in the case of mortality of oriental cockroaches caused by the TOTA, both formulae gave better knockdown and kill of all three species with direct than with space applications. The two larger species were more resistant than the smaller males of the German cockroach.

Pipkin (A. C.). **Experimental Studies on the Role of the Filth Flies in the Transmission of** *Endamoeba histolytica*.—*Amer. J. Hyg.* **49** no. 3 pp. 255–275, 26 refs. Lancaster, Pa., 1949.

Details are given of studies on the ability of flies of five species, *Musca domestica* L., *Lucilia pallescens* Shann., *Callitroga* (*Cochliomyia*) *macellaria* (F.), *Phormia regina* (Mg.) and *Sarcophaga dux* Thoms. (*misera*, auct.) var. *sarracenioides* Aldr., bred from stocks collected in Louisiana, to carry trophozoites and cysts of *Endamoeba histolytica* either externally or in the alimentary tract

and to deposit them in a viable condition. Modern culture techniques were used as a criterion of viability. Culturable trophozoites were not recovered from the surface of the bodies of any flies more than 1·5 minutes after contamination. The longest periods in minutes between feeding and recovery of culturable trophozoites in the crop and mid-gut, respectively, were 15 and 5 in *Musca*, *Lucilia* and *Phormia*, 25 and 15 in *Callitroga* and 40 and 30 in *Sarcophaga*. None was recovered from the rectal section of the hind-gut of any of the flies, but motile trophozoites were observed by direct examination of material from the rectum of *Phormia* and *Sarcophaga* 10 and 30 minutes after feeding, respectively. Culturable cysts were not recovered from the exterior of any fly after more than four minutes. They were found in the crop, mid-gut and rectum after remaining for 30, 240 and 180 minutes in *Musca*, 20, 90 and 180 in *Lucilia*, 20, 150 and 30 in *Phormia*, 30, 60 and 90 in *Callitroga*, and 210, 120 and 210 in *Sarcophaga*.

The data obtained were examined statistically, and this statistical treatment is discussed. With few exceptions, there was no significant difference between the mean times during which culturable cysts could be recovered from any given part of the alimentary tract of the different species. This suggests that the amoebicidal influences in any one part act equally in all five species. There was, however, a significant difference in the mean times during which subsequently culturable cysts could be recovered from crop, mid-gut and rectum of each. Statistically significant differences were also demonstrable between the mean maximum times of finding trophozoites as against cysts in the mid-gut, but no difference was demonstrable in mean times for these two stages in the crop. This suggests a greater amoebicidal activity against the trophozoites in the mid-gut.

Culturable trophozoites were recovered from the dejecta (probably the vomit) after periods of internal carriage ranging from 9 minutes in *Callitroga* to 17 in *Lucilia*, and culturable cysts were recovered from the vomit after maximum periods ranging from 39 minutes in *Callitroga* and *Sarcophaga* to 64 in *Phormia* and from faecal droplets after periods ranging from 172 minutes in *Musca* to 258 in *Callitroga*. There was no important difference between fly species in the effect of gut and crop passage on viability of cysts.

It is concluded that external carriage of trophozoites or cysts of *E. histolytica* by these flies probably plays no important part in the transmission of amoebiasis except in cases of gross neglect of sanitary rules. Trophozoites seldom survive passage through the alimentary canal of these flies, whereas cysts are much more resistant, but there is no evidence of detrimental action on either the trophozoites or the cysts in the crop. Not all of the material recovered from the crop by dissection was destined to be regurgitated. Recognisable trophozoites were not recovered from the vomit more than 19 minutes after feeding, and it seems unlikely that the ingestion of trophozoites by flies and their subsequent deposition in vomit on human food or drink is of great epidemiological importance. The passage of viable cysts in the fly vomit and faeces 64 and 258 minutes, respectively, after ingestion, suggests a possible method of transmission in nature under the conditions occurring in backward rural communities.

GAHAN (J. B.), DOWNS (W. G.) & CELIS S. (H.). **Control of *Anopheles pseudopunctipennis* in Mexico with DDT residual Sprays applied in Buildings. Part II.**—*Amer. J. Hyg.* **49** no. 3 pp. 285–289, 2 refs. Lancaster, Pa., 1949.

The following is based on the authors' summary. Reference is made to the entomological results obtained in 1945 in an experiment to determine whether deposits of DDT applied in spring on the walls and ceilings of houses in Mexican villages kill enough infected females of *Anopheles pseudopunctipennis* Theo. to control malaria [*R.A.E.*, B **38** 69], and those of the continuation of the

study in the three following years are discussed. DDT in an emulsified solution or as a suspension of a wettable powder was applied once each spring. In 19 series of observations, the numbers of *Anopheles* adults found per house averaged 0·02 in one treated village and 0·5 in another. The average per house in the second in 1945 when it was not treated had been 92.

Counts of larvae in rice-fields round the villages indicated that the treatment killed enough mosquitos to reduce breeding considerably. The greatest reduction occurred within 3–6 weeks of the completion of spraying of most of the houses for the first time. Although there was some further reduction in the second and third years, it appeared unlikely that complete eradication in these villages could be brought about by spraying of houses alone. Laboratory tests with first-generation adults of *A. pseudopunctipennis* reared from gravid females collected in an untreated village and one treated for four years indicated that the treatment had not resulted in the development of a strain resistant to DDT.

Snyder (J. C.), Murray (E. S.), Yeomans (A.), Zarafonetis (C. J. D.) & Wheeler (C. M.). **The Effect of Typhus Vaccine on the Numbers of Rickettsiae in Body Lice of Typhus Patients.**—*Amer. J. Hyg.* **49** no. 3 pp. 340–345, 1 fig., 13 refs. Lancaster, Pa., 1949.

The following is based on the authors' summary and discussion. Laboratory-reared body lice [*Pediculus humanus humanus* L.] were fed continuously for ten days on ten typhus patients who had not received immunisation before the onset of their illness, and on six patients who had received three or more doses of Cox-type typhus vaccine. The numbers of viable *Rickettsia prowazeki* in the lice at the end of the feeding period were estimated from the median immunising doses of suspensions of the lice inoculated into cotton rats, and the mean numbers per ml. in suspensions at a concentration of five lice per ml. were found to be 2,300 for the unvaccinated patients and 10 for the vaccinated patients. Whether this difference would suffice to prevent the development of an epidemic cannot be regarded as established, but the evidence from this and other studies indicates the possibility that a community-wide programme of immunisation with Cox-type vaccine of acceptable potency followed by one or more booster doses would reduce sharply the usual development of an epidemic, even though no measures were taken to control lice.

Kurtpinar (H.). **Spesifik bir myiasis amili olan** *Wohlfahrtia magnifica* **(Schiner 1862) ın, Türkiye ehli hayvanlar'ındaki rolü.** [The Rôle of the Myiasis-causing *W. magnifica* with Regard to domestic Animals in Turkey.] —*Türk. Vet. Hekim. Derneği Derg.* **20** pp. 349–355, 2 pls., 19 refs. Ankara, 1950. (With a Summary in English.)

Records are given of 12 cases of myiasis caused by larvae of *Wohlfahrtia magnifica* (Schin.) in sheep, goats, a horse, a cow, a buffalo and a dog, observed in and near Ankara in June–October 1950. The adults and larvae and the bionomics of the fly are briefly described. In laboratory observations, the pupal stage lasted 14 days in July–August. Notes on prevention and treatment are appended.

Girard (G.). *Haemodipsus lyriocephalus* **Burmeister,** *Ixodes ricinus* **Linné ectoparasites des lièvres, vecteurs possibles de tularémie en France.**—*C. R. Soc. Biol.* **144** no. 5–6 pp. 364–365, 3 refs. Paris, 1950.

Early in 1950, tularaemia was diagnosed in the department of Haute-Marne in north-eastern France in several hares and in men who contracted it from them. It was transmitted to mice by inoculation of suspensions of the crushed

bodies of two individuals of *Haemodipsus lyriocephalus* (Burm.) taken dead from the dead body of an infected hare and stored for seven days in a refrigerator and the bodies of two nymphs of *Ixodes ricinus* (L.) taken alive from another infected hare. The possible part played by these arthropods in transmitting tularaemia in Europe is discussed. Both nymphs and adults of the tick bite man as well as many animals susceptible to the disease, and the louse, which does not feed on man, could be a source of infection through the contact of its infected excreta with mucous membrane.

Holland (G. P.). **The Siphonaptera of Canada.**—*Publ. Dep. Agric. Can.* no. 817, 306 pp., 350 figs., 44 maps, 12 pp. refs. Ottawa, 1949.

In this bulletin, the author assembles all published and unpublished data on Canadian fleas available up to the end of 1946. Introductory sections include notes on the distribution and economic importance of fleas in Canada, the relationship of nearctic to palaearctic species, anatomy as applied to systematics, and host specificity. Tables are given showing the families of fleas that infest various orders of hosts, and there is a species list of Canadian hosts, showing the fleas recorded from them. The main section comprises keys to the Canadian genera, species and subspecies and a review of the order in Canada, where it is represented by 124 species with three additional subspecies. Families, subfamilies and genera are described, and also four new species and one new subspecies and the male or female of certain species previously known only from the opposite sex. The data on the remaining species comprise illustrations and sometimes brief notes on structures of particular diagnostic significance, references to the original descriptions, important supplementary descriptions if any, and papers recording the species in Canada ; previous locality and host records are summarised, and new records are given. Collecting methods and mounting techniques are dealt with in brief appendices.

Williams (R. W.). **Observations on the Bionomics of *Culicoides tristriatulus* Hoffman with Notes on *C. alaskensis* Wirth and other Species at Valdez, Alaska, Summer 1949 (Diptera, Heleidae).**—*Ann. ent. Soc. Amer.* **44** no. 2 pp. 173–183, 7 refs. Columbus, Ohio, 1951.

The following is substantially the author's summary. The life-history of *Culicoides tristriatulus* Hoffman was investigated in 1949 at the seaport community of Valdez, Alaska, where it is a serious pest, in an effort to facilitate the development of a control programme aimed at the destruction of the immature stages. It was found breeding only on the tide flats 0·8–2 miles north-west of the town, and within this region only in restricted areas where the proper vegetation was covered by 82–90 per cent. of all high tides or by the overflow of snow-water streams produced by each high tide. At times, the tide water was seven feet deep over parts of the breeding area. As many as 23 larvae were found in a soil sample 1 in. thick with an area of 36 sq. ins. The pH of the soil of the breeding areas ranged from 6·2 to 6·6 and the chloride content from 1,350 to 5,100 parts per million with an average of 3,000.

Adults were noted near the breeding places on 9th June and in the town on 16th. The prevailing winds were blowing from the breeding grounds to the town. Adults were most abundant in town from 4th July to 7th August and were still plentiful on 27th August, the last day of observation. Females probably live for at least 45 days. One blood-meal was necessary for egg development, but females in the laboratory never took a second though they were given at least one opportunity a day of doing so. Whether more than one batch of eggs is laid is not known. Eggs numbering 42–81 developed in 15 days at an estimated average temperature of 65·3°F., and eggs from the

same batch hatched in from 10 hours to 3 days at 64·4°F. when covered by tap water. Partly developed larvae of the new generation were found in the field on 9th August and subsequent days. The winter is passed in the larval stage in the soil, and there is one generation a year. Pupae first appeared about 1st June and were found floating at high tides among the vegetation of the breeding areas until 20th July. The pupal stage lasted 7·5–9·5 days at 60·8–64·4°F. Pupae are subjected to at least 16 high tides and some are carried from the breeding areas by receding tides and may be distributed further by currents in the bay. The temperature of the tide water, which can change considerably from day to day and is frequently much higher than that of the air, plays an important part in larval and pupal development. The average temperature at which the immature stages develop in nature is about 55°F. The activity of females is greatly influenced by light intensity, wind velocity and temperature. They appear to be attracted more to red and white cloth than to black. Apparently they can fly at least five miles aided by the wind, unless currents play an important part in distributing pupae. Ten other species of Ceratopogonids were found, but none is thought to be of any great importance at Valdez.

GABALDON (A.). **The nation-wide Campaign against Malaria in Venezuela.**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 2 pp. 113–160, 14 figs., 6 maps, 15 refs. London, 1949.

The following is substantially the author's summary. Venezuela is considered to be divided into three regions, Costa-Cordillera, Llanos and Guayana, which differ topographically, meteorologically, socially and economically. Malaria, which differs in extent with topographical and meteorological conditions, has played an important part in establishing the characteristics of the various regions. The chief vectors are *Anopheles albimanus* Wied. and *A. darlingi* Root [*R.A.E.*, B **36** 54]. The former is found mostly in the Costa-Cordillera and the latter in all three regions with different degrees of prevalence. *A. albimanus* is partly zoophilous, whereas *A. darlingi* is mainly anthropophilous and rests in houses during the day. As a result, they are affected differently by the spraying of houses with DDT. Numbers of *A. darlingi* are greatly reduced, and it may be eradicated, but there is no apparent reduction in the larval population of *A. albimanus* though the density in houses falls. The effect of DDT on malaria rates in areas where *A. albimanus* is the vector should therefore be considered to be the effect of interception only [*cf.* **37** 213].

Past studies show that the endemicity of malaria is low, with relatively small areas of hyperendemicity, and that epidemicity is generally high. This is because *A. darlingi* and *A. albimanus* are less efficient vectors than the chief Ethiopian or Oriental ones. The tendency to epidemics is particularly shown in the five-year cycles of the disease, which appear to be connected with similar cycles in the population density of the vectors, especially *A. darlingi*. These cycles also occur in other neotropical species, but the periodicities are different.

The Division of Malariology has organised an intensive programme of house-spraying with DDT since the end of 1945. Details of the whole organisation are given. By the end of 1948, the percentage of houses in the malaria zone directly protected with DDT was 37·2, and the percentage influenced was probably at least 50. As the regions where malaria prevalence is highest have been sprayed, the decline of malaria in the country as a whole is remarkable. The malaria death-rate fell from an average of 112·2 in 1941–45 to 14·8 in 1948. The success so far obtained indicates that it may be possible to eradicate malaria from the country. This possibility is discussed, and attention is called to the fact that the effectiveness of spraying with DDT should be measured

only in terms of reduction in malaria and not deduced from studies of its effect on mosquitos. It is emphasised that the eradication of malaria from large areas of the world will depend on the conviction that the malariologists themselves may have that it can be done.

MORRIS (K. R. S.). **Planning the Control of Sleeping Sickness.**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 2 pp. 165–198, 2 pls., 4 maps, 2 graphs, 15 refs. London, 1949.

A study of the admissions to centres for treating sleeping sickness in the Lawra district of the north-western Gold Coast provided the data used in planning a programme of control of *Glossina palpalis* (R.-D.) and *G. tachinoides* Westw., the vectors of *Trypanosoma gambiense* in this epidemic area [*R.A.E.*, B **40** 5], and in observing the effects of the measures on the incidence of the disease over a period of ten years. The area and the extent of the epidemic are described [*cf.* **34** 19] ; over 30,000 sq. miles of the Upper Volta territory were affected in 1938. In Lawra district, there were relatively few cases along the Black Volta, where fly-belt is heavy and continuous, with *G. tachinoides* predominant and usually abundant, but infection was heavy on the tributaries and especially their headwaters, where fly-belt is lighter and less continuous or even reduced to isolated groves, and *G. palpalis* is proportionately more numerous though the numbers are smaller. The main centres of infection were of three types ; some were within a mile of continuous fly-belt, some were associated with very localised patches of fly-belt (often occurring as sacred groves [**37** 111]), and the others were villages that had no fly-belt within 2–3 miles but were on trade routes or had their own market. Presumably, high infection rates can be built up only by the assembly of an exacting complex of factors [*cf.* **40** 6]. It appeared that infections were being acquired both " immediately " when there was a constant and intimate contact between the fly and the people and " remotely " at some distance from the village in which they appeared. Cases may appear in villages normally free from *Glossina* through the habit of members of the *palpalis* group of moving up comparatively open waterways during the rains and forming temporary wet-season colonies in thickets and banana or mango plantations. There was much remote infection.

Both *G. palpalis* and *G. tachinoides* are important vectors, but *G. palpalis* is the more dangerous on account of its preference for man and domestic animals as hosts. It is present in every heavily infected area in the Gold Coast and in most of those in the Ivory Coast, sometimes without *G. tachinoides*. Within the Gold Coast, sleeping sickness is absent or almost absent from areas where *G. tachinoides* is the only species. It occurs in a large tract of Northern Nigeria where only *G. tachinoides* is present, and outbreaks of considerable intensity have developed in the presence of this species alone in the Mossi country [**40** 6] between the upper Red and White Voltas, but here there were no extensive areas of high infection, and the fly's habitat and available water are so restricted that very close contact is maintained between the people and the fly almost continuously throughout the year. In these conditions and in the absence of a choice of host, as in groves, *G. tachinoides* is as important a vector as *G. palpalis*.

It was apparent that localised measures against *Glossina* at the most obvious sources of infection would give only partial control of sleeping sickness. To eliminate the disease, measures giving a high degree of control of *Glossina* would have to be applied throughout the infected area. It also appeared that if a major reduction of the epidemic could be effected in this way, it might be unnecessary to clear the Volta, as the small amount of transmission there might cease or become negligible when the amount of infection circulating in the district was substantially reduced. This would enormously lighten both initial clearing and maintenance, and was particularly important in view

of the indications that *G. palpalis* and *G. tachinoides* might be eradicated by selective clearing of the species of trees and shrubs forming their dry-season habitat. This method depends for success on its application over complete river systems, working from the headwater downwards [**34** 18], and this was out of the question on the Volta, particularly as it is an international boundary. It was subsequently applied with success to its tributaries, and 1,100 sq. miles of Lawra district with a population of 90,000 were freed from *G. palpalis* and *G. tachinoides* between 1940 and 1945, at a total cost of £4,500. The permanent tsetse communities disappeared on each stretch of river as soon as clearing was completed, and continuous observation on three cleared rivers yielded 0–9 flies per year in places where 2,000–7,500 per year were taken before clearing. The catch at a control point on the uncleared Volta was 20,127 flies in 1947.

The incidence of sleeping sickness in the eradication area fell by 97 per cent. between 1938 and 1947. Fly regularly migrated up the tributaries for a few miles from the Volta fly-belt in the wet season, but the numbers caught along a river diminished in geometrical ratio as the distance from the source of migration increased, so that migrating flies seldom appeared beyond 5–6 miles upstream from the Volta or about three miles in a straight line. Where riverside vegetation was abundant, temporary breeding colonies were sometimes formed in wet-season habitats, but these died out quickly at the end of the rains. In the neighbouring Wa district, protective clearings only were used, and reductions of 80 and 50 per cent. in pre-clearing incidence of sleeping sickness were effected in two blocks of country, the reductions being proportionate to the number and length of the clearings. In south-western Wa, where no control measures were applied, the number of cases increased by over 100 per cent. between 1940 and 1947.

It is concluded that eradication of *Glossina* is essential for the complete control of epidemic sleeping sickness and has the added advantage of controlling trypanosomiasis of stock. A modification of selective clearing leading to the eradication of the fly-belt vegetation has been applied throughout the Lawra area of reclamation and has given such a high degree of stability that maintenance can be taken over by the natives at a population density as low as 20 per square mile, a level below which sleeping sickness is not a serious problem. About 1,500 people have settled voluntarily along one of the cleared rivers, and over 4,000 acres of new farms have been broken since clearing was finished.

RAGAB (H. A.). **Observations on the isolated Gut of the Mosquito.**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 2 pp. 225–230, 1 fig., 14 refs. London, 1949.

The following is based on the author's summary. Attempts to cultivate the sexual stage of *Plasmodium gallinaceum* on the stomach of *Aëdes aegypti* (L.) *in vitro* showed that the stomach could remain alive (contracting) for as long as four days, but that the oöcysts, which were 5–6 days old at the time of transplantation, did not develop further [*cf. R.A.E.*, B **38** 163].

RUSSELL (P. F.). **Malaria. Basic Principles briefly stated.**—9×5¾ ins., xi+210 pp., 64 figs. (incl. 3 col. pls.), 1 fldg. table, 12½ pp. refs. Oxford, Blackwell Sci. Publ., 1952. Price 35*s*.

The purpose of this monograph is to give a simple summary of the principles of malariology. A very brief historical introduction is followed by diagnostic tables for the identification of the species of *Plasmodium* that infect man, and accounts of the development of the *Plasmodium* in the mosquito and in the vertebrate host and of pathology, clinical features of malaria and treatment.

The various stages in the development of an Anopheline, including the features of importance in differentiation of species, are described, and notes

are given on the characters of an effective vector and on physiology and bionomics. There are lists of the vectors of human malaria and tabulated data on the characteristics (mainly breeding places, adult habits and areas of importance) of the principal ones. A chapter on epidemiology includes data on methods of making a malaria survey, and one on preventive and control measures incorporates notes on the newer insecticides. There are tables showing the metric equivalents of various British and United States weights and measures.

Thompson (G. A.). **Anopheline Threshold of Malaria Transmission noted in Jamaica.**—*Publ. Hlth Rep.* **65** no. 21 pp. 692–695, 2 graphs, 1 ref. Washington, D.C., 1950.

Experience in Porto Rico during the second world war indicated that few, if any, new cases of malaria were likely to be contracted there by military personnel living in screened quarters if the number of adults of *Anopheles albimanus* Wied. caught per night per animal-bait trap [*R.A.E.*, B **23** 302] in the intracantonment area did not rise above two. A study of the relationship between the abundance of *A. albimanus* and malaria transmission at a military installation in Jamaica was therefore made in the autumn of 1945 ; the average catch per trap per night during a week is termed the density index. Only one case of malaria was contracted by military personnel and transmission among civilians was rare during the 18 months preceding that period, when low rainfall and adequate malaria control measures kept the population of *A. albimanus* low, but rainfall was heavy in September and October, the density index was over five in each week of October, and four cases occurred among troops and a much larger number among civilians in the second fortnight of that month. During the next six weeks, four applications of DDT as a larvicide were made over the base from aircraft, and the density index was well below one throughout this period, although nearly 10 ins. rain fell during the third week of November. There were no cases of malaria among the troops, and the number in the native population gradually decreased until the end of December. Thus, with the return of the vector abundance to that indicated by density indices of less than five, transmission of malaria largely ceased.

Papers noticed by Title only.

Sun (Yun-pei) & Sun (Jung-yi Tung). **Microbioassay of Insecticides** [in plant or animal tissue], **with special Reference to Aldrin and Dieldrin.**—*J. econ. Ent.* **45** no. 1 pp. 26–37, 16 refs. Menasha, Wis., 1952. [See *R.A.E.*, A **40** 167.]

Arant (F. S.). **Toxicity of Aldrin to Chickens.**—*J. econ. Ent.* **45** no. 1 p. 121, 2 refs. Menasha, Wis., 1952. [See *R.A.E.*, A **40** 177.]

Turner (H. F.) & Eden (W. G.). **Toxicity of Chlordane to Chickens.**—*J. econ. Ent.* **45** no. 1 p. 130, 3 refs. Menasha, Wis., 1952. [See *R.A.E.*, A **40** 178.]

Eichler (W.). **Erste Ergänzung zu Kélers „Übersicht über die gesamte Literatur der Mallophagen".** [First Supplement to Kéler's " A Survey of the Literature on the Mallophaga " (373 titles up to 1934)].—*Z. angew. Ent.* **31** pt. 4 pp. 617–635. Berlin, 1950. [*Cf. R.A.E.*, B **27** 120.]

Hassett (C. C.) & Jenkins (D. W.). **The Uptake and Effect of Radio-phosphorus in Mosquitoes.**—*Physiol. Zool.* **24** no. 3 pp. 257–266, 5 graphs, 8 refs. Chicago, Ill., 1951.

The following is based on the authors' summary. Radioactive larvae and adults of *Aëdes aegypti* (L.) were obtained by keeping the larvae in a rearing medium (tap water and finely ground dog food) containing radioactive phosphorus as $H_3P^{32}O_4$ or a phosphate derived from it. The larvae pupated in the medium, and the degree of radioactivity of the adults depended on sex, the age of the larvae when treatment was begun, the concentration of radio-phosphorus, and the number of larvae per unit of medium. The most satisfactory method of producing radioactive adults for large-scale uses was treatment of late third-instar and fourth-instar larvae with about 0·1 microcurie P^{32} per larva in 1 ml. water. Both higher and lower concentrations of phosphorus resulted in adults with lower radioactivity. Females contained about three times as much phosphorus as males. The larvae are able to concentrate P^{32} to at least 75 times its concentration in the medium.

Phosphorus entered the larvae through the gut from ingested food, through the anal gills, and perhaps through the integument. Removal of the anal gills retarded the uptake of phosphate but did not affect the final level. The distribution of the entering P^{32} was general throughout the organism, with somewhat heavier concentrations in the Malpighian tubes and in parts where rapid metabolic processes were occurring.

Effects of radiation were noticed at relatively low concentrations of P^{32} in the rearing medium (0·05 microcurie per ml.) in the earlier instars. Resistance increased with age, but at concentrations above 5 microcuries per ml., practically no adults emerged. Radiation effects, such as retardation or inhibition of growth and death occurred at high concentrations. Mating and oviposition occurred normally in adults from larvae reared in P^{32} solutions of 1 microcurie per ml. or less.

Adult mosquitos of both sexes were also made radioactive by feeding them on raisins soaked in P^{32}, radioactive flowers and sugar solutions fortified with P^{32}, and females by feeding them on rats or rabbits into which P^{32} had been injected.

Hopkins (G. H. E.). **Mosquitoes of the Ethiopian Region. I. Larval Bionomics of Mosquitoes and Taxonomy of Culicine Larvae.**—2nd edn. with notes and addenda by P. F. Mattingly, $10\frac{1}{4}\times7\frac{1}{4}$ ins., viii+355 pp., 211 figs., 9 pp. refs. London, Brit. Mus. (Nat. Hist.), 1952. Price 45*s*.

The arrangement of this book is the same as that of the first edition [*R.A.E.*, B **24** 123], but the text has been revised and extended by the author to incorporate information available up to 1946 and by P. F. Mattingly to include further findings available up to September 1951. Most of the changes are in the main section in which the fourth-instar larvae of species of the genera other than *Anopheles* are described and notes are given on their breeding places and habits. The number of species dealt with in this section has been increased from 248 to 334 and the number of pages it occupies from 213 to 308. Expansion of the text has been relatively greatest under genera and subgenera on which much new material has been acquired in the course of studies of the epidemiology of yellow fever.

Downs (W. G.) & Baker (R. H.). **Experiments in crossing** *Aëdes* (*Stegomyia*) *aegypti* **Linnaeus and** *Aëdes* (*Stegomyia*) *albopictus* **Skuse.**—*Science* **109** no. 2826 pp. 200–201, 5 refs. Lancaster, Pa., 1949.

Toumanoff in 1937 and 1939 and Hoang-Tich-Try in 1939 reported several successes in obtaining hybrid offspring by crossing females of *Aëdes albopictus* (Skuse) with males of *A. aegypti* (L.) [*R.A.E.*, B **26** 98 ; **27** 47, 263], but the

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former succeeded in only one of the experiments in which *aegypti* females and *albopictus* males were used [**26** 98]. In experiments carried out by the authors in New York in 1944, no eggs hatched and but few were laid in four attempts to cross *albopictus* females and *aegypti* males, but progeny were reared in three experiments out of four with *aegypti* females and *albopictus* males. All progeny examined, including the F_2 generation in one test, resembled *A. aegypti* in every detail. The *albopictus* females did not feed readily on the chick provided as a source of blood but the *aegypti* females fed well. Sperm was found in the spermatheca of only one of 24 *albopictus* females dissected, although copulation had been observed. The possibility that fertilisation by the male of the other species is not a true fertilisation but serves to stimulate parthenogenetic development of the ovum is suggested, but it is pointed out that both male and female hybrids were obtained.

The fact that the females used in the successful crosses were *A. aegypti* in the authors' experiments whereas they were *A. albopictus* in those of Toumanoff and Hoang-Tich-Try is not stressed in this paper, but may be of interest in consideration of the conclusions on reciprocal crosses noticed below [see next two abstracts].

Woodhill (A. R.). **Further Notes on experimental Crossing within the *Aëdes scutellaris* Group of Species (Diptera, Culicidae).**—*Proc. Linn. Soc. N. S. W.* **75** pt. 5–6 pp. 251–253, 5 refs. Sydney, 1950.

When F_1 hybrids obtained by crossing males of *Aëdes scutellaris katherinensis* Woodhill and females of *A. s. scutellaris* (Wlk.) [*cf. R.A.E.*, B **38** 176] were back crossed with both sexes of the parents, the only sterile cross was between hybrid males and *katherinensis* females. Whereas no eggs of this cross hatched, all those of the other three did so. Egg production was much higher in the two crosses in which the hybrid was the male parent than in the others. In all crosses, copulation was frequent and living spermatozoa were seen in the spermathecae of sample females. Adults were reared from the fertile crosses. Attempts were made to cross both sexes of *A. pseudoscutellaris* (Theo.) with *A. s. scutellaris* and *A. s. katherinensis*. In all crosses, copulation was often observed and living spermatozoa were seen in the spermathecae of the females, but all were completely sterile.

It is concluded from this and the previous experiment [*loc. cit.*] that some factor renders females of *katherinensis* sterile unless mated with males of their own subspecies. The experiments of Downes & Baker with *A. aegypti* (L.) and *A. albopictus* (Skuse) [see preceding abstract] and those of Perry with *A. s. scutellaris* and *A. pernotatus* Farner & Bohart [**39** 210] are cited as similar examples of sterility in one cross while the reciprocal cross was fertile. It appears that this phenomenon is peculiar to closely related forms of mosquitos. The author's results confirm the opinion of Farner & Bohart [**34** 37] that *A. pseudoscutellaris* is specifically distinct from *A. s. scutellaris* (*hebrideus* Edw.), as the two are evidently completely isolated genetically. With regard to Perry's conclusion that *A. scutellaris* and *A. pernotatus* Farner & Bohart are distinct because of the difficulty of crossing them, it is pointed out that only small numbers of mosquitos were used. The author found the same difficulty with small numbers of *A. s. scutellaris* and *A. s. katherinensis*, but when 60–100 individuals of both sexes were used, large numbers of hybrids were readily obtained.

Smith-White (S.). **A Note on non-reciprocal Fertility in Matings between Subspecies of Mosquitoes.**—*Proc. Linn. Soc. N. S. W.* **75** pt. 5–6 pp. 279–281, 9 refs. Sydney, 1950.

The non-reciprocal fertility of matings between closely related mosquitos [see preceding abstract, etc.] is of considerable interest in relation to speciation,

and its origin and nature are also of genetical interest because an interaction between the nucleus and the cytoplasm may be involved. Undefined cytoplasmic incompatibility is probably frequent as an isolating mechanism between species, but where it involves complete and absolute isolation, it is not susceptible to analysis.

Two possible explanations of the sterility are considered. The first is that the sperm may fail to enter the eggs either because of the serological conditions in the female or for mechanical or other reasons. The low egg production reported by Downs & Baker when females of *Aëdes albopictus* (Skuse) were mated with *A. aegypti* (L.) [*R.A.E.*, B **40** 106] may indicate that copulation alone provided insufficient stimulus to ovulation in this cross. The second possibility is that the sperm enters the eggs, but that fertilisation does not result or that the hybrid embryos die at a very early stage. This possibility has implications of far-reaching significance, involving an incompatibility interaction between the cytoplasm of the egg and the nuclear genom in the haploid sperm of the male parent or the hybrid embryo. In the successful reciprocal mating, the cytoplasm of the egg must be fully compatible with the genom of the male parent both in the haploid sperm and the hybrid embryo. A formal scheme is given that could explain such behaviour and leads to predictions that can be verified or refuted experimentally. It depends on the assumption that the insect sperm contributes little or no cytoplasm to the zygote.

Nash (T. A. M.). **Some Observations on resting Tsetse-fly Populations, and Evidence that *Glossina medicorum* is a Carrier of Trypanosomes.**—*Bull. ent. Res.* **43** pt. 1 pp. 33–42, 3 refs. London, 1952.

It has been shown [*R.A.E.*, B **38** 140] that certain species of *Glossina* that do not readily attack man can be found at rest by examining the trunks of saplings and stems of creepers. An account is here given of further observations on *Glossina medicorum* Aust. and *G. fusca* (Wlk.) made with this resting-haunt technique in the Olokemeji Forest Reserve, Nigeria, at the end of the rains in 1950. During 5½ collecting days, six fly boys took 124 individuals of *G. medicorum* and 76 of *G. fusca*, all resting head downwards on trunks and stems, whereas only one fly came to man. Rather less than half of each species were females. The former species appeared to be commoner near the river and the latter away from it. Of 15 recently gorged individuals of *G. medicorum* and eight of *G. fusca* examined all contained mammalian blood. Gorged flies were very numerous except in the morning after a night of rain. Attempts to establish the time of activity were unsuccessful, but the scanty evidence obtained indicated that at the end of the rains both species feed only during twilight or bright moonlight. A morning's search by five men failed to produce any pupae in the classical breeding sites of *Glossina*. The resting-haunt technique was developed in unnatural forest with an understorey of saplings of introduced species of trees [*loc. cit.*], but it has also been satisfactorily tested in natural forest and is effective provided the undergrowth has been sufficiently suppressed by canopy to make quiet access possible. Most of the flies found were resting on vertically hanging creeper stems or thin saplings. Out of 29 males and 21 females of *G. medicorum* dissected, three males were found to contain mature trypanosomes of the *Trypanosoma vivax* group and one male and three females mature trypanosomes of the *T. congolense* group. It would appear therefore that *G. medicorum* is potentially of veterinary importance.

An attempt was also made to apply the resting-haunt technique to the study of *G. morsitans* Westw. in the woodland savannah zone of northern Nigeria. Of 897 individuals attracted to man in an investigation in January and February 1951, in the mid-dry season, 21 per cent. were females, 18 per

cent. were young and 15, 38 and 46 per cent. were gorged, starved and in an intermediate hunger stage, respectively. Of 826 taken on trees in the presence of cattle, 40 per cent. were females, 5 per cent. were young, and 69, 7 and 24 per cent. were gorged, starved or intermediate. Whereas the average height at which the gorged flies were taken was 2·9 ft. above ground level, the average heights at which the intermediate and starved flies rested appeared to be about 6 ft. and was probably much higher, as many flies resting high up are not seen or are inaccessible. Flies were often seen resting about 14 ft. above ground-level. Most of the gorged flies were resting on tree-trunks in the vertical plane with the head upwards, whereas most of the others were on the under-side of horizontal branches. By adopting this position and resting higher, they increase their field of vision, and so improve their chances of avoiding predators and finding a host. There appeared to be no relation between resting position and sex.

Whitnall (A. B. M.), Thorburn (J. A.), McHardy (W. M.), Whitehead (G. B.) & Meerholz (F.). **A BHC-resistant Tick.**—*Bull. ent. Res.* **43** pt. 1 pp. 51–65, 1 pl., 3 figs., 13 refs. London, 1952.

The following is based on the authors' introduction and summary. Investigations having shown that the γ isomer of BHC (benzene hexachloride) is extremely toxic to the arsenic-resistant strain of *Boophilus decoloratus* (Koch) [*R.A.E.*, B **37** 209, etc.], dip-washes containing 50 parts γ BHC per million were extensively used from early 1946 and safeguarded the cattle industry in large areas of the Eastern Cape Province, Natal, Zululand and Swaziland. In March 1948, however, it was observed that the dips were failing to control the ticks on three farms in the East London district, and during experiments in the Bathurst district in December 1948, it was noticed that while *Amblyomma hebraeum* Koch which was formerly less susceptible [*cf.* **37** 210], was controlled by 100 p.p.m. γ BHC [**39** 50], the sprays and dips were ineffective against *B. decoloratus*. Investigations on the reactions of the tick to various insecticides were therefore made ; in recording the results, concentrations of γ BHC are based on a supposed concentration of 10 per cent. in the crude product. *In vitro* experiments showed that adult females taken from the localities in question could withstand high concentrations of γ BHC, while females of the same species from other areas were readily killed. Even 1,000 p.p.m. did not give complete control of ticks from resistant areas, and different sources of γ BHC were equally ineffective. Laboratory experiments further indicated that the ticks were still resistant to arsenic. No BHC-resistant tick was found that was not resistant to arsenic also. Toxaphene and chlordan were ineffective in the laboratory against BHC-resistant ticks, but controlled those that were sensitive to BHC. DDT gave moderate results in the laboratory against both resistant and sensitive ticks.

In field experiments, weekly spraying with 0·16 per cent. As_2O_3 failed to control *B. decoloratus* on cattle at one of the farms in the East London district and one in the Bathurst district. The ticks also developed normally at both farms when cattle were treated weekly with 100 p.p.m. γ BHC in sprays or dips. Even spraying with 500 p.p.m. γ BHC was unsatisfactory at the one where it was tried. In 1949, 1,000 p.p.m. γ BHC was necessary to give results comparable with those obtained with 50 p.p.m. in 1947. DDT and toxaphene gave good results in the field. These are not fully understood, for *in vitro* tests suggested that only moderate and poor results, respectively, could be expected against BHC-resistant ticks. The persistent action of these insecticides, by killing many larvae that are attempting to attach themselves, may account for the favourable results, or alternatively excitant and repellent action may be

responsible. Toxaphene was used at 2,500 and 5,000 p.p.m. in emulsion and DDT at 2,000, 2,500 and 5,000 p.p.m. p,p'isomer in wettable-powder suspension, both as sprays. One test with a chlordan emulsion spray at 2,500 p.p.m. gave unsatisfactory results. The BHC-resistant strain of *B. decoloratus* appeared in the same localities as those in which the arsenic-resistant strain first appeared some ten years previously, and it is evident that resistance is spreading rapidly. The areas in which the resistant strain is found have a higher rainfall and are more humid than those in which the ticks are not resistant.

BARLOW (F.) & HADAWAY (A. B.). **Some Factors affecting the Availability of Contact Insecticides.**—*Bull. ent. Res.* **43** pt. 1 pp. 91–100, 15 refs. London, 1952.

All adults of *Glossina palpalis* (R.-D.) were killed when exposed for 15 seconds on glass plates, three hours after these had been sprayed with 5 per cent. p,p'DDT in kerosene at 100 mg. DDT per sq. ft., but after 24 hours, crystallisation had taken place, the needle crystals were lying flat on the surface and contact for 15 seconds caused no mortality [*cf. R.A.E.*, B **38** 204]. This was to be expected, as the outer layers of the epicuticle of an insect are lipoid and easily wetted by oils, so that a contact insecticide should be more rapidly effective in an oil solution than as a dry deposit, provided that it is equally available in both forms. The DDT crystals that had formed 24 hours after glass plates had been sprayed at the same dosage with DDT in a mixture of kerosene and cotton-seed oil (9 : 1) were coated with a tacky oil film, and complete kill was obtained among tsetse flies exposed to the deposit for 15 seconds at this time [*cf.* **37** 229–230]. Similarly, exposure of adults of *Aëdes aegypti* (L.) to 25 mg. DDT per sq. ft. on glass plates confirmed the superiority of continuous oil films or crystalline deposits with a tacky film over dry crystalline deposits. A commercial oil-bound DDT suspension also gave better results against *A. aegypti* than DDT crystals of the most effective size (10–20 μ) on a non-absorptive surface because of the presence of the oil solution of DDT, which was not effective on an absorptive plaster surface. The inclusion of a non-drying, non-volatile oil should make the film even more persistent than the semi-drying cotton-seed oil. S. Davidovici, Z. Levinson & S. Reuter in unpublished work noted that the addition to the solvent of a substance to prevent the rapid crystallisation of DDT would prolong effectiveness. The most promising results were obtained with lanoline and related substances. The inclusion of 5 per cent. lanoline in kerosene solutions considerably increased effectiveness against house-flies [*Musca domestica* L.] even when these were resistant to DDT, but only for three weeks.

Tests with *A. aegypti* on compressed fibreboard sprayed with kerosene solutions of DDT confirmed the results obtained by Parkin & Green [**36** 18] in that the toxicity of the film increased after the first exposure of the mosquitos. A solution of DDT in oil remained in a supersaturated condition in and around the fibres. When crystallisation was stimulated by mechanical means, such as the movement of insects, the resulting crystals projected from the treated surface at right angles to it ; it is suggested that such crystals can be easily detached and are more readily available to insects than the oil solution from which they were derived. When a 5 per cent. kerosene solution of DDT was sprayed at about 100 mg. DDT per sq. ft. on fibreboard, spontaneous crystallisation occurred slowly over several days. The spontaneously grown crystals were 50–300 μ long, rather stout and arranged in isolated clusters, whereas the crystals induced by mechanical means appeared as a dense uniform mat of thin needles about 50–150 μ long, completely obscuring the board and projecting for a considerable distance above it. Maximum growth of induced crystals was obtained by stimulation a few hours after the application of the solution.

After 4–5 days, when presumably all the DDT had crystallised spontaneously, stimulation had no effect. When the solution was applied as single drops to the surface of various materials and crystallisation was stimulated by brushing, it occurred to a markedly greater extent on fibreboard and filter paper than on any other material; cardboard, Essex board, cork and velvet responded noticeably, but the crystals on them were only about 1–5 μ long. There was no difference between spontaneous and induced crystallisation on poplin, a short-pile carpet, unpainted wood and a porcelain tile, and no detectable crystallisation on mud blocks. The application of oil solutions to absorptive materials such as plaster or mud blocks results in the absorption of the insecticide with the solvent. DDT always crystallised on fibrous materials in the form of needles projecting away from the fibres, whereas crystals formed from kerosene solutions on glass are usually recumbent. None of various other chlorinated-hydrocarbon insecticides applied as 5 per cent. solutions in kerosene to fibreboard showed the same bloom of induced crystals as DDT. The potency of insecticides of different physical properties should therefore not be compared by application in volatile oil solution to such materials as fibreboard or filter paper. Application as single drops to fibreboard of various concentrations of p,p'DDT in 38 solvents differing in chemical nature and boiling point, showed that the behaviour of the insecticide depended on the physical properties of the solvent (principally its volatility and ability to dissolve DDT) and not on its constitution. The best induced crystallisation was obtained with intermediate concentrations (5–10 per cent.) and solvents of medium boiling points (about 120–200°C.). It is concluded that insecticides such as DDT are more effective if they are dissolved in an oil film that is available to the insect, but that when the solvent has evaporated the effectiveness of the deposit is governed by its physical condition, which varies with the solvent, concentration and type of surface, provided that climatic conditions are constant. The observations made concerning oil solutions also apply largely to emulsions.

Insecticides are more readily available on absorptive materials when they are applied as solids in suspension than as solutions [*cf.* **38** 22]. Some of the more important factors that influenced the availability of particles are their size [**39** 51], the percentage of inert diluent and adherence to the sprayed surface. Adherence may be influenced considerably by wetting agents. These cause the insecticide particles to adhere strongly to non-porous materials. Mosquitos (*A. aegypti*) in contact with deposits of 10–20 μ DDT crystals at 25 mg. per sq. ft. picked up 0·48 mmg. DDT per insect in 30 seconds on plaster but only 0·1 mmg. in 8 minutes on glass. Mean percentage kills in 24 hours after these contacts were 62 and 12, respectively. Adherence, and therefore, toxicity, also varied with humidity, availability always being greatest at low humidities. There were also differences in the availability of 0–10 μ crystals to mosquitos on different porous materials, probably because of differences in adhesion of the small particles to the substrate. The addition of adhesives to aqueous suspensions decreased availability, and a balance between resistance to weathering and availability to insects must be sought by careful choice of the adhesive and the concentration at which it is used. When comparing the potency of several insecticides in the laboratory, care should be taken that every substance is in the same physical condition and equally available.

VAN TIEL (N.). **On "Supona", a new Type of DDT Suspension.**—*Bull. ent. Res.* **43** pt. 1 pp. 187–202, 6 graphs, 12 refs. London, 1952.

The following is mainly based on the author's introduction and summary. The investigation here reported, which was made in Uganda, was designed to provide detailed information on the merits of sprays containing two recently

formulated DDT suspension concentrates, " Supona "-D and " Supona "-DB, the former for the control of *Glossina palpalis* (R.-D.) by application to vegetation from the ground and both for leaving toxic deposits in African mud huts against mosquitos. When DDT is applied to vegetation in ordinary solution, much is lost by penetration into the leaves [*R.A.E.*, B **36** 19]. A water-dispersible powder has not this disadvantage, but the deposits it forms are not resistant enough to tropical rains. So far, emulsified solutions have given the best results. " Supona "-D and " Supona "-DB are thin pastes, easy to pour and to dilute with water. They contain about 50 per cent. DDT and 39 per cent. DDT with 13 per cent. technical BHC (benzene hexachloride), respectively, suspended in a complex colloidal oil-water system. As the oil used is a poor solvent for DDT and BHC, nearly all the active material is suspended as minute solid particles. When the concentrates are diluted with water, suspensions are obtained that are considerably more stable than suspensions of the current dispersible powders. Owing to the extremely small size of the solid particles (less than 25 μ in the case of DDT), there is no risk of spraying nozzles becoming clogged, and deposits are highly effective as there is no masking of the active material by inert fillers.

" Supona "-D and an emulsion concentrate containing about 30 per cent. DDT dissolved in a mineral-oil phase were compared for the control of *G. palpalis*. Both were diluted to contain 5 per cent. DDT. Laboratory experiments with spray deposits on leaves showed that " Supona "-D was somewhat inferior to the emulsion in initial toxicity and stability in tropical sunlight, but it was superior to it in resistance to artificial rain. Vegetation normally inhabited by *G. palpalis* on two islands in Lake Victoria, amounting to about 5–10 per cent. of the total area, was sprayed four times at fortnightly intervals to a height of 7 ft., " Supona "-D being used on one and the emulsion on the other. The soil below shrubs and tree trunks was also sprayed. The emulsion rapidly reduced the population of *G. palpalis* to 22 per cent. of the original level and it remained at that level for 17 weeks after the last treatment. Then a marked increase set in, coinciding with a period of heavy rains, until 35 weeks after the last treatment the population density was the same as before treatment. " Supona "-D also caused an immediate fall to 22 per cent. of the original population, but a fortnight after the last treatment, notwithstanding frequent rains, there was a further reduction, so that six weeks after the last spraying the population had been reduced to 3 per cent., after which it remained constant at 6 per cent. for at least six weeks. There was only a very slight upward tendency up to 36 weeks after the last treatment. A more definite continuous increase then set in until the population reached 39 per cent. of its original density 51 weeks after the last treatment. Chemical analyses of samples of leaves of *Alchornea cordata* taken four weeks after the last application of spray showed comparable deposits of DDT left by both formulations ; 22 weeks after the last treatment, no DDT was present where the emulsion had been used and only very slight amounts on foliage treated with the " Supona "-D.

Laboratory experiments with *G. palpalis* as test insects showed that deposits of 50 or 40 mg. DDT per sq. ft. on mud surfaces from " Supona "-D are more toxic than deposits of 50 mg. from a 33 per cent. dispersible powder. A small experiment designed to compare " Supona "-D with DDT dispersible powder as a lasting spray against mosquitos was made in three native mud huts and three wooden experimental huts, all of which were occupied on the nights before the mosquitos were collected. The roofs and walls of the mud huts were sprayed to give deposits of 100 and 50 mg. DDT per sq. ft., respectively, and a deposit of 175 mg. DDT per sq. ft. was applied in the wooden huts. The results over a period of six months showed that " Supona "-D was on the whole more effective than the dispersible powder, which was, however,

completely effective against *Anopheles gambiae* Giles and *A. funestus* Giles for at least four months after treatment. Anophelines were somewhat more susceptible than other mosquitos to both treatments.

Thirty badly infested inhabited native mud huts were used to compare "Supona"-D, "Supona"-DB and DDT dispersible powder. The mean deposits per sq. ft. on sample papers were, respectively, 116 mg. DDT, 53 mg. DDT with 18 mg. BHC, and 104 mg. DDT. After treatment, the numbers of living mosquitos per hut fell to 1-2 per cent. of what they had been before. They then rose gradually for 12 weeks, the rise being slightly more pronounced in the case of the dispersible powder. Over an observation period of 29 weeks, no significant difference was apparent in the persistency of "Supona"-D and the dispersible powder, both of which allowed a gradual rise in population to about 30 per cent. of the original figure. The best results were obtained with "Supona"-DB, which allowed recovery to only 8 per cent. 29 weeks after treatment.

PARKER (A. H.). **The Effect of a Difference in Temperature and Humidity on certain Reactions of Female** *Aëdes aegypti* **(L.).**—*Bull. ent. Res.* **43** pt. 1 pp. 221–229, 1 fig., 6 refs. London, 1952.

Sir R. Christophers found females of *Aëdes aegypti* (L.) to be attracted by a warm dry surface and to be unaffected by an unwarmed moist surface, whereas the author found that a warm dry surface had no effect, while an unwarmed moist surface exerted a definite attraction [*R.A.E.*, B **37** 57–58]. The ambient temperature and relative humidity, however, were 25°C. [77°F.] and 80–90 per cent. in Christophers' experiments and 28°C. [82·4°F.] and 50–70 per cent. (usually near 50 per cent.) in those of the author, and the temperatures of the warm surfaces were 40 and 36–40°C. [104 and 96·8–104°F.]. The relevant experiments were therefore repeated under these two sets of conditions. The material and methods used are described, and the results are given and discussed. They showed some variation but indicated that a dry surface at 36°C. was more attractive and more evocative of probing at 25°C. and 85–90 per cent. humidity than at 28°C. and 50–55 per cent., and the same appeared to be true, though not to the same degree, of the response to a dry surface at 40°C. A moist surface at room temperature, on the other hand, appeared to be less attractive and to produce less probing at 25°C. and 85–90 per cent. humidity than at 28°C. and 50–55 per cent. It is concluded that the differences in temperature and humidity could account for part but not all of the discrepancy noted in the previous experiments. There are indications that the remainder may have been caused by a conditioning effect of the temperature and humidity at which the mosquitos were reared and kept before the experiments. In the new experiments, the rearing and experimental room (except during actual tests) was kept at 25°C. and 60–80 per cent. humidity whereas in the author's previous work, it was kept at 28°C. and 50–70 per cent. The results emphasise the need for a full description of the climatic conditions under which studies of behaviour of the type discussed are made [*cf.* **40** 39].

WEIDNER (H.). **Die Malariamückenbrutplätze Nordgriechenlands und ihre Sanierung.** [The Breeding Sites of Malaria Mosquitos in north Greece and their Sanitation.]—*Z. angew. Ent.* **32** pt. 1 pp. 86–133, 13 figs., 33 refs. Berlin, 1950.

The most dangerous vector of malaria in Greek Macedonia is *Anopheles maculipennis* Mg. var. *sacharovi* Favr. *A. m. maculipennis* (*typicus*), *A. m. subalpinus* Hackett & Lewis and *A. superpictus* Grassi are of less importance,

while *A. claviger* (Mg.) plays little or no part in transmission [*cf. R.A.E.*, B **23** 296 ; **36** 39]. Observations during the war years showed that larvae of *A. maculipennis* were common in still, clear water with abundant vegetation, provided that this did not cause heavy shade and disturb the surface when blown by the wind (as was done by *Phragmites*) or cover the surface and so prevent the larvae from breathing (as did *Lemna*). *A. m. sacharovi* tolerates higher salinity than the other two varieties and was common in the coastal marshes [*cf.* **21** 168]. *A. superpictus* was found in hilly and mountainous country and in the plains, breeding in streams and rivers with a pebble or gravel bed and no vegetation. The larvae preferred sunny sites, but avoided the force of the current or sheltered from it behind or under rocks and stones.

The natural and artificial factors responsible for the local existence of Anopheline breeding places are discussed in detail and illustrated by examples. The former include a sinking coastline, resulting in the formation of marshes, poor natural drainage caused by silting, which has been increased by deforestation, the drying out of streams in summer with the formation of small pools, and the existence of springs with no drainage, and man-made breeding places are provided by flooded pits and quarries, rice-fields, water allowed to leak from artesian wells or conduits, and reservoirs of all types. Accounts are given, largely from the literature, of local attempts to drain marshes by cutting ditches or improving the flow of rivers, some of which have proved successful in reducing the number of breeding sites. Field tests of larvicides and experiments on biological control were carried out in 1943–44. One boggy area that had been formed by water from an artesian well and was a prolific breeding place was completely freed from larvae by colonisation of *Lemna* on the water. *Gambusia* was bred and liberated in pools that do not dry out during the summer, but the fish suffered high mortality when transported in bulk from the breeding tanks to the pools and few survived the winter. The larvicides tested were calcium arsenite, phenothiazine (thiodiphenylamine) and Neocid (which contains DDT) ; the first two were applied in dusts, and all three in aqueous suspensions and in emulsions of oil with which they were mixed before emulsification. Good results were obtained with calcium arsenite in emulsion, but 1 per cent. phenothiazine in road dust and sprays of 1 oz. phenothiazine or Neocid and 2 fl. oz. oil in 6 gals. water at 12 pints per 40–50 sq. yards were more effective and economical and resulted in 97–100 per cent. mortality. Reasons why malaria is commoner in villages than in towns and seasonal fluctuations in the Anopheline population [*cf.* **21** 167] are discussed.

Sullivan (T. D.), McGregor (T.), Eads (R. B.) & Davis (D. J.). **Incidence of *Trypanosoma cruzi*, Chagas, in *Triatoma* (Hemiptera, Reduviidae) in Texas.**—*Amer. J. trop. Med.* **29** no. 4 pp. 453–458, 1 map, 13 refs. Baltimore, Md., 1949.

Of 859 bugs of the genus *Triatoma* examined in Texas between 1941 and 1947 286 were found naturally infected with *Trypanosoma cruzi*. Those that were specifically identified comprised *T. gerstaeckeri* (Stål), *T. lecticularius* (Stål) (*heidemanni* Neiva), *T. protracta* (Uhl.), *T. sanguisuga* (Lec.), *T. neotomae* Neiva and *T. rubida* (Uhl.). One or more individuals of each of these species was infected. No subspecific identifications were made. Records of bugs received, examined and found infected are given by counties. The percentage infection in each of the six species and an unidentified group is also shown. Only 27·1 per cent. of the nymphs examined were infected as compared with 47·8 per cent. of the adults. Most of the bugs were from nests of wood rats (*Neotoma*) or from beneath the bark of trees near them. Some were taken in houses and reported to have fed on man, cats or dogs. Bugs from one farm were

uninfected while there was evidence that they were feeding on fowls, but those collected later when wood rats were the most likely source of food were infected.

Link (V. B.). **Plague among wild Rodents in Rio Arriba County, New Mexico.** —*Amer. J. trop. Med.* **29** no. 4 pp. 493–500, 3 maps, 24 refs. Baltimore, Md., 1949.

During 1938–48, plague infection was found in 11 counties in New Mexico in fleas from rodents of 12 species as well as in tissue from two of the species and lice from one (*Marmota flaviventris*). A list is given of the rodents concerned. In 1948, a study lasting 14 weeks was made of mammals and their ectoparasites in Rio Arriba County, following a report that prairie dogs (*Cynomys*) were dying in unusual numbers. Evidence is given that plague had been present there for six years. In the 14 weeks, 3,295 rodents were collected, and 4,632 fleas were obtained from them, as well as three tissue samples from *Cynomys* and 38 lice from marmots (*M. flaviventris*). Some of the fleas were identified, and lists are given of these with the hosts from which they were taken. Plague was isolated three times from tissue, 15 times from fleas of *Cynomys*, once from marmot fleas and once from marmot lice. Fleas from the marmots from which the pool of positive lice was obtained were negative. Indirect evidence of plague in smaller rodents was obtained from a study of population numbers.

Petrie (P. W. R.). **Epidemic Typhus in southwestern Arabia.**—*Amer. J. trop. Med.* **29** no. 4 pp. 501–526, 9 figs., 3 refs. Baltimore, Md., 1949.

An account is given of an outbreak of louse-borne typhus in the Yemen that is believed to be the first recorded from Arabia proper. The Yemen is a fertile, mountainous region and contains about half of the population of Arabia. It has a temperate climate, and infestation with lice [*Pediculus humanus humanus* L. and *P. h. capitis* Deg.] is high. Acute cases were first recognised in 1939, but there is evidence that the disease had probably been occurring in the country since about 1936. There was a fulminating outbreak early in 1940 and another that began in November 1941 and continued for some years. Early in 1944, the disease spread into the Western Aden Protectorate. Measures were immediately taken to isolate contacts and restrict the movement of Yemenis in Aden and its Protectorate and prevent the entry of more, and the first wave consisting of 15 known cases ended at the end of the month. There were other outbreaks, however, some of them severe, in subsequent months, and a programme of dusting people and their clothing for the control of lice was adopted in foci of the disease and on the main trade routes from the Yemen to Aden. AL 63, containing naphthalene, derris and other ingredients [*cf. R.A.E.*, B **36** 218, etc.], was first used and later 5 per cent. DDT dust. Both were effective if dusting was properly done, but there was a tendency for people to wash off the AL 63 as it was somewhat irritant. Southern Arabia appeared to have become free from typhus by 1946. The epidemiological importance of the human factor is stressed.

Waddell (M. B.). **Comparative Efficacy of certain South American *Aëdes* and *Haemagogus* Mosquitoes as Laboratory Vectors of Yellow Fever.**—*Amer. J. trop. Med.* **29** no. 4 pp. 567–575, 17 refs. Baltimore, Md., 1949.

An account is given of experiments made to evaluate certain species of *Haemagogus* and *Aëdes* as vectors of yellow fever in the laboratory. *A. leucocelaenus* Dyar & Shann., in which the virus has been found in nature [*R.A.E.*, B **27** 121 ; **32** 184], was shown by L. Whitman, G. S. Tulloch & the author

to be an efficient vector. In six experiments with 13 females of this mosquito, infection was twice transmitted to rhesus monkeys (*Macaca mulatta*) by bite. One monkey contracted a fatal infection after being bitten by a single mosquito 22 days after its infective meal and the other became infected following bites by six mosquitos that had received an infective meal 20 days previously. In experiments by a technique already noticed [**39** 71], the ratios of the transmission rates to those by *A. aegypti* (L.), under identical conditions, were 1·29 for *A. leucocelaenus*, 0·73 for a mixed group of *H. capricorni* Lutz and *H. spegazzinii* Brèthes, 0·45 for *H. equinus* Theo., 0·31 for *A. scapularis* (Rond.) and 0·16 for *H. splendens* Will. After the infective meal, mosquitos were kept at 20°C. [68°F.] except for exposure to 30–31°C. [86–87·8°F.] for 4–5 hours each week day. In the earlier experiment with *H. equinus* [**39** 71], vectors had been maintained constantly at the higher temperature.

Doetschman (W. H.) & Furman (D. P.). **A tropical Chigger, *Eutrombicula batatas* (Linn.) attacking Man in California.**—*Amer. J. trop. Med.* **29** no. 4 pp. 605–608, 7 refs. Baltimore, Md., 1949.

Three species of Trombiculids have been reported to attack man in the United States [*R.A.E.*, B **39** 141], and one of them, *Trombicula* (*Eutrombicula*) *alfreddugèsi* (Oudm.), has been found on other hosts in California, but the State has long been considered free from Trombiculid infestation of man. In recent years, however, reports of typical infestations have been frequent and three larvae collected from members of one family in Tulare County in 1945 were identified in 1947 as *T.* (*Eutrombicula*) *batatas* (L.). This is the first record of *T. batatas* in the United States outside Florida, Georgia and Alabama. It is now known to occur in two counties in the southern half of the San Joaquin Valley, and available evidence indicates that the distribution of Trombiculids infesting man in California is much more general than is known. Most complaints of infestation are received in the warm months. It is not known whether *T. batatas* is a vector of any disease of man, but it is a very annoying pest. Control is complicated as it is reported to have a wide host range.

Statens Skadedyrlaboratorium. Årsberetning 1949–1950. [Government Pest Infestation Laboratory (Stored Products and Household Pests). Annual Report 1949–50.]—41 pp., 10 figs. Springforbi, 1951. (With Summaries in English.)

In addition to information noticed elsewhere [*R.A.E.*, A **40** 218], this second report [*cf.* B **38** 196] contains the results of further investigations on house-flies [*Musca domestica* L.] resistant to insecticides in Denmark. At the beginning of 1949, most populations of the fly throughout the country were resistant to deposits of DDT, and BHC (benzene hexachloride) or chlordan was substituted for it. Tests on walls showed that chlordan was the more persistent. The effect was generally good during the summer, but some flies resistant to BHC were found in October. In tests in which acetone solutions were placed on the thorax of the females, the median lethal dose for these flies was about 20 times as great as that for susceptible strains. They were also highly resistant to DDT. BHC had been used for only three months in the locality from which these flies came and was stated to have been unsatisfactory from the beginning. As the flies were breeding in calf-boxes in sprayed premises, the rapid development of resistance may have resulted from selection in the larval as well as the adult stage. Another strain of flies resistant to BHC was observed in March 1950, and the median lethal dose for these was found to be 200 times that for susceptible strains. Some two-thirds of the flies were highly

resistant to DDT and the rest quite susceptible. This strain was also breeding in calf-boxes in premises sprayed with BHC during the summer of 1949, and it appeared to have lost part of its resistance to DDT during that period. Both these resistant strains were susceptible to chlordan.

In **Simple Equipment and Methods for Use in insecticidal Tests** (pp. 31–35), which is appended, J. KEIDING describes the use of earthenware flower-pots for tests of the effect of toxic deposits on *M. domestica*. The pots are lime-washed on the inside, to simulate the walls of animal quarters, left for at least three weeks, and then sprayed on the inside on a turntable to give the desired toxic deposit. For testing, the pots are inverted on glass plates, flies are introduced through the holes in the bottom, which are then plugged with cotton, and the pots with their glass covers are turned right way up. If exposure is for a limited time, the pots are again inverted after the desired interval, a stream of carbon dioxide introduced through the hole in the bottom, and the anaesthetised flies collected from the glass plates. He also reports that a small cage consisting of cellophane stretched over a light metal ring (9 cm. in diameter and 2·5 cm. high) has proved useful in several ways for confining house-flies on treated surfaces. If necessary, the flies can be fed by piercing the cellophane with a syringe, and risk of condensation is avoided, as the cellophane allows the escape of water vapour.

HARRISON (R. A.). **Tests with some Insecticides on DDT-resistant Houseflies.** —*N. Z. J. Sci. Tech.* **32** (B) no. 6 pp. 5–11, 2 figs., 3 refs. Wellington, N.Z., 1951.

During 1949, several populations of *Musca domestica* L. collected in Auckland were shown to be resistant to DDT deposits [*R.A.E.*, B **40** 92]. In this paper, the results are given of preliminary tests of the effects of deposits of γ BHC (benzene hexachloride), chlordan, dieldrin (compound 497 [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene]) and DDD (1,1-bis(p-chlorophenyl)-2,2-dichloroethane) made against the resistant line G [*loc. cit.*] and a non-resistant line in an attempt to find substitutes for DDT. They indicated that the males of line G were relatively resistant to all four insecticides and the females to dieldrin and DDD, the differences between lines being highly significant, but the females of the two lines did not differ significantly in susceptibility to BHC and chlordan. BHC, chlordan and dieldrin were effective enough against the line G flies to suggest that they might be of use in control of strains resistant to DDT, but DDD was not.

SCHECHTER (M. S.), LAFORGE (F. B.), ZIMMERLI (A.) & THOMAS (J. M.). **Crystalline Allethrin Isomer.**—*J. Amer. chem. Soc.* **73** pp. 3541–3542, 5 refs. Easton, Pa., 1951.

Allethrin, which is obtained by acylation of *dl*-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one (*dl*-allethrolone) with a mixture of *dl-cis-* and *dl-trans*-chrysanthemum monocarboxylic acid chlorides, may be considered a mixture of four racemic forms (or eight individual optical and geometric isomers). Two racemic forms are esters of the *cis* acid and two of the *trans* acid.

When a sample of molecularly distilled allethrin was cooled to a low temperature, it crystallised in part, as did samples of commercial allethrin kept at about 4°C. Cold filtration and recrystallisation from isooctane or pentane gave colourless crystals with a melting point of 50·5–51°C., which gave rise to *dl-trans*-chrysanthemum monocarboxylic acid on saponification. Acylation of *dl*-allethrolone with *dl-cis*-chrysanthemum monocarboxylic acid chloride gave an ester mixture (boiling point 146–149° (0·4 mm.), n^{25}D 1·5070), which did not

crystallise when cooled and seeded with the crystalline portion of allethrin, whereas acylation of *dl*-allethrolone with the *dl-trans* acid chloride gave an ester mixture (b.p. 147–150° (0·4 mm.), n^{25}D 1·5047) that crystallised in part when cooled and seeded. When this ester mixture was dissolved in isooctane, cooled and filtered at about −30°C., about half was obtained as the crystalline form and the remainder was left as an oil (n^{25}D 1·5050) on removal of the solvent from the filtrate *in vacuo*. The crystalline portion, when recrystallised from isooctane, melted at 50·5–51° and did not depress the melting point of the crystalline compound obtained from allethrin. The crystalline compound and the oil are designated the α-*dl-trans* and β-*dl-trans* isomers of allethrin, respectively ; one must consist of the pair of esters formed by the *d-trans* acid with *d*-allethrolone and *l-trans* acid with *l*-allethrolone and the other of the pair formed by the *d-trans* acid with *l*-allethrolone and *l-trans* acid with *d*-allethrolone.

Tests on house-flies [*Musca domestica* L.] indicate that the α-*dl-trans* isomer is less effective and the β-*dl-trans* isomer more effective than allethrin, and it is considered that the pure, crystalline α-*dl-trans* isomer should serve as a useful reference standard in insecticide tests and for checking chemical analytical methods for substances of the pyrethrin or allethrin type.

Mackerras (I. M.), Ratcliffe (F. N.), Gilmour (D.) & Mules (M. W.). **The Dispersal of DDT from Aircraft for Mosquito Control. An Account of Experiments on the Use of Combat Aircraft for aerial Spraying.**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 257, 64 pp., 9 pls., 14 figs., 8 refs. Melbourne, 1950.

Preliminary experiments on the application from the air of sprays of DDT in oil for the control of Anophelines as an anti-malaria measure, primarily in vast areas in New Guinea, showed that by disconnecting the outer wing tanks of large combat aircraft (Beaufort bombers) from the rest of the fuel system, the fuel-dumping mechanism could be used for spraying, practically without further modification. An experimental programme was therefore devised, which consisted of three phases. Preliminary experiments with oil alone were made at Laverton, near Melbourne, in June–July 1944, to study the emission system, the flight pattern and the range of wind speeds within which spraying was effective and practicable, and to train the team. These were followed in August–November by area-spraying tests against *Aëdes vigilax* (Skuse) at Cairns, Queensland, to assess the efficiency of the spray, and finally areas in New Guinea carrying natural uncontrolled populations of *Anopheles punctulatus* Dön., sometimes including *A. farauti* Lav. and intermediates, were treated experimentally in December 1944 and January 1945 to determine the effectiveness of the technique against these particular mosquitos. This work merged into an operational phase. The apparatus as finally standardised is described.

The Laverton experiments are only summarised, as they were carried out before the importance of the very small, drifting droplets in the control of adult Anophelines under a canopy of vegetation was fully appreciated and these could not be detected by the technique used. The coarser fractions are useful when control of larvae as well as adults is needed, as the breeding places of *A. punctulatus* are characteristically exposed to sunlight and therefore accessible to falling droplets. Almost complete kill of larvae was subsequently obtained in unshaded waters. The experiments showed that reasonably even distribution of spray could be achieved by flying at 100 ft. and spacing runs 100 yards apart provided that the wind-speed was between 4 and 10 miles per hour. When

the importance of finer droplets was realised, both upper and lower wind-speed limits were reduced.

Five tests carried out at Cairns are described, the results are discussed and it is concluded that a kill of 95 per cent. or more of the *Aëdes* adults and almost complete kill of larvae could be obtained by spraying with 5 per cent. DDT in light mineral oil with 0·014 per cent. pyrethrins at 2·5 quarts per acre. It was desirable to spray as soon as possible after first light during a temperature inversion in a wind of less than 6 m.p.h. and to make cross-wind runs. The effect of treatment sometimes remained obvious for more than 12 days. There was much evidence of the importance of the smaller droplets for killing adults. Pupae were almost unharmed. Other Diptera and Neuroptera were seriously affected.

From the four New-Guinea tests, it is concluded that spraying from the air with 2–2·5 quarts per acre of 5 per cent. DDT and 0·014 per cent. pyrethrins in oil generally kills over 90 per cent. of Anopheline adults and nearly all larvae provided it is completed before the sun begins to warm the ground and the wind velocity does not exceed 6 m.p.h. Spraying in conditions of complete calm is undesirable. With suitable extensions of the basic flight pattern, spraying from the air can give good control of mosquitos in all types of territory. It was widely used in the operational phase against mosquitos in New Guinea, Bougainville (Solomon Islands) and Borneo and against *Musca domestica* L. on entering enemy-occupied territory in Bougainville and New Britain at the end of the war. In New Guinea, the most important operation was at Wewak, where 12 sq. miles were sprayed per month, and malaria incidence, which was high because of the occurrence of an atebrin-resistant parasite, declined as Anopheline control from the ground and the air became effective. On Tumleo Island near Aitape on the north coast of New Guinea, which was sprayed with 1·8 quarts 5 per cent. DDT per acre to check the transmission of dengue by *Aëdes scutellaris* (Wlk.), 94 per cent. reduction in adult population, as indicated by catching-station records, followed the first treatment. A second spraying, five days later, apparently eliminated adults, but the population had risen to about 20 per cent. of its original level within five days, presumably through adult emergence. The spray at the dosage used was highly selective, killing only adult mosquitos and flies, and mosquito larvae in exposed water [*cf. R.A.E.*, B **36** 175].

The operations carried out in Bougainville, which are described as typical, consisted of the treatment in stabilised areas of patches of jungle swamp that it was impracticable to reach effectively from the ground, the treatment of beach-head bases, which were usually occupied for a comparatively short time, and the treatment of areas immediately after they were won from the enemy. The dosage used was always 2 quarts per acre of 5 per cent. DDT. The Anopheline was *A. farauti*. Even though it does not always breed in exposed waters like *A. punctulatus*, the treatment could apparently be relied on to kill almost all the larvae in the area. Spraying against extremely heavy populations of *M. domestica* in Bougainville and New Britain gave excellent control, although in the latter case it was carried out when conditions were unfavourable.

Wilson (T.) & Reid (J. A.). **Malaria among Prisoners of War in Siam ("F" Force).**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 3 pp. 257–272, 2 graphs, 1 map, 9 refs. London, 1949.

In April 1943, the Japanese sent a labour force of 7,000 British and Australian prisoners of war, few of whom had had malaria, to work on railway

construction in hilly jungle country in Siam, about 200 miles north-west of Bangkok near the Burma frontier. The authors were attached as advisers on malaria and nutrition. During the eight months that the force spent in Siam, 3,087 men died. Malaria was recorded as a cause in 338 of these deaths, but there is reason to think that it was a contributory cause to many more. Of the 3,122 who returned to Singapore in December, 801 were carriers of malaria parasites and many others were still under treatment. During seven weeks of January-February 1944, there was a malaria attack rate among them of 18·8 per 1,000 men per day. The authors describe the situations in the various camps in Siam that they were allowed to visit and the conditions that gave rise to this heavy infection rate, and give a list of the 22 species of *Anopheles* known to them to have been recorded from Siam, all of which are among the 25 recorded by Sandosham [*R.A.E.*, B **36** 112]. The species found by them in surveys for larvae were *A. aitkeni* James, *A. barbumbrosus* Strickl. & Chowd., *A. kochi* Dön., *A. leucosphyrus* Dön., *A. maculatus* Theo., *A. minimus* Theo. and *A. vagus* Dön. No adult Anophelines were caught or seen. The number of breeding places and larvae of each species found at each camp, together with the dates of residence in these camps, are shown in a table. *A. maculatus* and *A. minimus* were considered to be the principal vectors [*cf.* **21** 90]. The latter was found and the former was abundant only at the two most malarious camps, both of which were near abandoned rice-fields. *A. leucosphyrus*, which was present at all camps, may also have played some part in transmission [*cf.* **36** 203–204]. The form of the species found [*cf.* **24** 234 ; **37** 145] could not be determined. It is suggested that transmission in the hilly regions of Siam is likely to be greatest in the wet season.

Payzin (S.). **Orta Anadolu'da bir köyde Q hummasi salgını.** [An Outbreak of Q Fever in a Village in central Anatolia.]—*Turk. Bull. Hyg. exp. Biol.* **8** no. 3 pp. 116–125, 1 fldg. table, 4 refs. Ankara, 1948. (With a Summary in English.) **Fas, Ankara, İzmir çıkağlı Q hummasi suşları ile bağışıklık deneyleri.** [Cross-Immunity Tests with original Strains of Q Fever from Morocco, Ankara and Smyrna.]—*T.c.* pp. 126–131, 5 refs. (With a Summary in English.) **Epidemiology of Q Fever in Turkey.**—*Op. cit.* **9** no. 2 pp. 111–120, 1 map, 1 fig., 29 refs. 1949. Also in Turkish pp. 101–110.

Golem (S. B.). **La fièvre Q en Turquie ; l'épidémiologie et une revue sommaire sur la fièvre Q des animaux.**—*Op. cit.* **11** no. 1 pp. 22–38, 1 map, 39 refs. Ankara, 1951. Also in Turkish pp. 1–21, 1 map, 43 refs.

In the first of these papers, the author gives a preliminary account of an epidemic of Q fever that occurred in a village with a population of 800 in the district of Konya, central Turkey, in 1948. There was one fatal case. Sanitary conditions in the village were poor, and living rooms were in communication with stables and barns, in which wool was stored. The patients were not infested by lice, and none showed tick bites. *Melophagus ovinus* (L.) was taken from the wool, and adults of *Ornithodoros lahorensis* Neum. and an unidentified Ixodid from the stables and barns. *Rickettsia burneti* could not be isolated from any of these arthropods by injection of suspensions into guineapigs, but wool soiled with tick excreta is considered to have been the source of infection, as it was taken into the houses, where dust from it might easily have been inhaled [*cf. R.A.E.*, B **37** 195, etc.]. In an experiment, adults of *O. lahorensis* acquired the infection after feeding on an infected guineapig and were still infected after a month.

It is stated in the second paper that Q fever is endemic in Turkey, and strains of *R. burneti* have been isolated from several districts. In cross-immunity

tests in guineapigs, a strain isolated by G. Blanc from ticks in Morocco [**38** 221] and three from Smyrna protected against a strain from Ankara, and two strains from Ankara protected against the Moroccan strain.

The third paper contains a more detailed account of the outbreak in 1948 and a map showing the localities in Turkey in which cases of Q fever have been recorded. The rickettsia is also apparently present in domestic animals in that country, and Q fever antibodies have been demonstrated there in sera from sheep and goats and in sera from the blood and milk of cows. Of 98 human cases in Turkey, 57 (including all 21 from the village) occurred in farmers and others who had contact with domestic animals, and the village epidemic began during the sheep-shearing time. Inhalation of infective wool dust and droplet infection were the probable causes.

The last paper comprises a review of knowledge on Q fever in Turkey. The characteristics of *R. burneti* and its distribution are described, and information is given on the seasonal occurrence of the disease, which occurs in spring and summer in Turkey, the sections of the population affected, and the probable modes of infection. The importance in this connection of contact with domestic animals is stressed, and the finding of *R. burneti* in the milk of a cow and a ewe is recorded. Observations in other countries on natural and artificial infection in animals are reviewed, and a list is given of the ticks that have been found naturally infected in the various continents. This is supplemented in the Turkish version by a similar list of the ticks infected experimentally, also arranged by continents. No naturally infected ticks have been found in Turkey. It is reported that the examples of *O. lahorensis* that fed on the infected guineapig, as described in the first paper, failed to transmit infection to healthy guineapigs on which they subsequently fed but were themselves still infected after 19 months.

PAYZIN (S.). *O. lahorensis* **kenelerinde** *enteritidis* **Gaertner basili.** [*Salmonella enteritidis* Gaertner in the Tick, *Ornithodoros lahorensis*.]—*Turk. Bull. Hyg. exp. Biol.* **9** no. 1 pp. 82–85. Ankara, 1949. (With a Summary in English.)

A strain of *Salmonella enteritidis* [*cf. R.A.E.*, B **32** 84] was isolated from examples of *Ornithodoros lahorensis* Neum. collected in a village in central Turkey in connection with investigations on Q fever [see preceding abstract]. The unidentified Ixodid was not infected.

PAPERS NOTICED BY TITLE ONLY.

EDWARDS jr. (F. I.). **Report on Parathion** [Methods of Analysis].—*J. Ass. off. agric. Chem.* **34** no. 3 pp. 686–689, 4 refs. Washington, D.C., 1951. [See *R.A.E.*, A **40** 204.]

[MONCHADSKIĬ (A. S.).] **Мончадский (A. C.). The Larvae of blood-sucking Mosquitos of the U.S.S.R. and adjoining Countries (Subfam. Culicinae).** [*In Russian.*]—*Opred. Faune SSSR* no. 37, 2nd revd. edn., 290 pp., 142 figs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1951. Price 24 *rub.* 25 *kop.* [*Cf. R.A.E.*, B **25** 90.]

[Olenev (N. O.).] **Оленев (Н.О.). On the Effect of the Toxic Principles of higher Plants on Ixodid Ticks.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **71** no. 6 pp. 1119–1120, 3 refs. Moscow, 1950.

Since the patchiness of the distribution of Ixodid ticks in forest and other habitats in the Soviet Union might be the result of a repellent or toxic action on them of certain plants, tests were carried out in which unfed larvae of *Ixodes ricinus* (L.) were exposed to the vapours from various pulped plant parts. They were confined in covered petri dishes or test-tubes at a short distance from the plant material, and the results showed that they were killed in 15 minutes or less by the winter buds or bark from the branches of *Prunus padus* or the leaves of *P. laurocerasus*, killed in 17 and 25 minutes by lemon rind and garlic bulb, immobilised in 10–15 minutes and killed in 2–4 hours by leaves of *Thuja occidentalis*, and killed in several days by onion bulb. When placed in the juice of lemon rind or onion, they died in 7–10 and 40 minutes, respectively.

In subsidiary tests with pulped leaves of *P. laurocerasus*, adults and nymphs of *Argas persicus* (Oken) ceased to move in ten minutes and died in 2–48 hours, and adults of *Pulex irritans* L. and *Cimex lectularius* L. died in three and five minutes, respectively. Adults of *Drosophila funebris* (F.) were killed in 50–90 seconds by leaves of *P. laurocerasus* and in 20–25 minutes by orange rind.

Jellison (W. L.). **Tularemia. Geographical Distribution of "Deerfly Fever" and the Biting Fly, *Chrysops discalis* Williston.**—*Publ. Hlth Rep.* **65** no 41 pp. 1321–1329, 2 maps, 12 refs. Washington, D. C., 1950.

"Deer-fly fever" is an epidemiological type of tularaemia occurring in man in the western United States and western Provinces of Canada and characterised by having the initial lesion on an exposed part of the body and often a history of bite by a deer-fly (*Chrysops*) [*cf. R.A.E.*, B **25** 133; **32** 9]. Its season is almost limited to June, July and August. The records of cases of tularaemia in man in the United States designated as deer-fly fever by the reporting physician or attributed to the bites of flies are tabulated, and the localities are shown on a map. The distribution of cases, virtually all of which were from six western States, does not correspond with that of deer-flies in general, the causal agent or its important rodent reservoirs, all of which are very widely dispersed over the United States. It does, however, roughly correspond with the distribution of *C. discalis* Will., which has been shown to transmit the disease in some localities [**35** 97, etc.]. The factor that apparently makes *C. discalis* a particularly effective vector and is lacking in other species of *Chrysops* and *Tabanus* may be a special predilection for feeding on rabbits and other rodents.

Brown (A. W. A.). **Insect Control by Chemicals.**—8½×5½ ins., vii+817 pp., 101 figs., many refs. New York, N.Y., J. Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., 1951. Price $12.50 or £5.

The subjects of this comprehensive review of the properties and uses of insecticides, with (in brackets) the space devoted to each, comprise: the chemical and physical properties of the insecticides in current use, classified as chlorinated hydrocarbons, organic phosphates, other synthetic organic compounds, botanicals, inorganic compounds and fumigants, and of the materials, such as solvents and dust diluents, that are used with them (62 pp.); the structure of organic chemicals and its relation to their toxicity to insects (107 pp.); the ways in which poisons can enter insects through the cuticle, respiratory system and digestive tract, and other factors that affect their

toxicity and the relative susceptibility of different species and stages of insects to them (80 pp.) ; the modes of action of insecticides of various types (85 pp.) ; equipment for their application, and the physical factors that affect their dispersal (77 pp.) ; their application from aircraft (53 pp.) ; toxicity and hazards to man and domestic animals (64 pp.) and to plants (43 pp.) ; the ways in which chemicals have been used for the control of insects and mites that attack plants (94 pp.), and of other pests, including insects, mites and ticks injurious to man and livestock and pests of stored products (52 pp.) ; and the effects of insecticides on the balance of animal populations and the appearances of resistant strains of susceptible species (61 pp.).

Extensive bibliographies, to which constant references are made, are appended to the various sections.

Lepigre (A. L.). **Insectes du logis et du magasin. Lutte contre les insectes ennemis du commerçant et de la ménagère. Reconnaissance—moeurs et moyens de destruction.**—339 pp., 242 figs. Algiers, Insectarium, Jardin d'Essai, 1951.

This practical handbook on household pests and their control, which has been compiled with special reference to France and Algeria, deals with some 120 species or groups of arthropods, of which about three-quarters infest stored products, damage timber, furniture and fabrics, or are a nuisance in buildings. The others are of medical or veterinary interest and include some that are not primarily household pests, such as *Stomoxys calcitrans* (L.), Trombiculids, ticks that sometimes attack dogs or cats, and ticks, lice and mites that infest poultry. Information on the appearance, habits, life-history, distribution and importance of the pests is followed by chapters on their control, and on the preparation, properties and uses of the insecticides recommended against them. An alphabetical list of the pests, the animals and birds they attack and the diseases they transmit to man, dogs and poultry, with cross references to the bionomics and relevant control measures, is given at the beginning of the book, and an appendix shows the nature and content of the toxic materials in a number of proprietary insecticide preparations.

Yasumatsu (K.). **Rearing of Flea Larvae on various Diets.**—*J. Fac. Agric. Kyushu Univ.* **9** no. 2 pp. 121–126, 13 refs. Fukuoka, 1949.

The media that have been used by various workers to rear flea larvae are briefly reviewed from the literature, and an account is given of experiments in Japan on the development of larvae of *Xenopsylla* (*Ceratophyllus*) *cheopis* (Roths.) on nine single media and 23 mixtures containing them. The larvae were introduced when 0–24 hours old into bottles containing sawdust and the substance to be tested. Of larvae reared on dried and powdered rat excrement and on floor dust collected under straw mats, 95 and 92 per cent., respectively, reached the adult stage. The next highest percentage emergence on a single medium (36·7) was obtained with a mixed cereal and bean flour [*cf.* *R.A.E.*, B **39** 99]. The only other single media that allowed of any emergence were dried and powdered ox-blood and silkworm pupae. A mixture of the flour and ox-blood and one of the pupae and rat excrement allowed of 96·9 and 90 per cent. emergence, respectively, but with about one-third of the mixtures, including one containing flour and ox-liver and some containing rat excrement, ox-blood or both, there was no emergence at all. The duration of the combined larval and pupal stages was shortest on the dust from beneath straw mats.

JACKSON (C. H. N.). **On two Advances of Tsetse-fly in central Tanganyika.**—*Proc. R. ent. Soc. Lond.* (A) **25** pt. 4–6 pp. 29–32, 1 fldg. map, 2 refs. London, 1950.

The following is substantially the author's summary. *Glossina morsitans* Westw. has for some years past been spreading towards Singida in central Tanganyika by extension of the fly-belts on the east and the west, and these two belts have now joined at the southern tip of the main Singida cultivated area. Its spread from the east has in general been in accordance with expectation, but it has crossed a wide area of dense thorn woodland in the south-east, which was thought to provide an effective barrier [*R.A.E.*, B **22** 55], and has started a colony in the north in highly deciduous small-tree savannah practically without thickets in the presence of a large population of game animals. There have been fewer natural obstacles to extension of the western belt, but a settled area intended to provide a barrier has been crossed and the advance has been particularly marked in the thorn woodland bordering the Wembere Steppe. A third advance, from the south, has apparently been stopped by dense thicket. The eastern belt certainly had its origin in the western belt, but the fly then receded in both directions and left a gap about 200 miles wide between them. The separation has evidently been long, because the flies of the eastern belt have become differentiated as a paler race.

PARKER (A. H.). **Studies on the Eggs of certain Biting Midges (*Culicoides* Latreille) occurring in Scotland.**—*Proc. R. ent. Soc. Lond.* (A) **25** pt. 4–6 pp. 43–52, 11 refs. London, 1950.

An account is given of observations on the appearance and laboratory development of eggs of several species of *Culicoides* occurring in Scotland [*cf. R.A.E.*, B **39** 194, etc.]. Most hatched a few days after being laid, but eggs of *C. grisescens* Edw. laid in September did not hatch until February or later, thus indicating that this species spends much of the colder part of the year in the egg stage. Experiments on viability were largely made with eggs of *C. pulicaris* vars. *pulicaris* (L.) and *punctatus* (Mg.) as, except for eggs of the group of *C. obsoletus* (Mg.), which comprised several largely indistinguishable species, they were the only ones available in sufficient numbers. They usually survived exposure to the dry atmosphere of a desiccator for 12 hours and sometimes for 18 or 24 hours but never for 48. Survival tended to increase with the age of the eggs treated. Hatching, when it occurred, was delayed. When kept on moist filter paper inside a closed petri dish, the eggs survived exposure to 30°C. [86°F.] for 12, 24 and 48 hours, and to 35°C. [95°F.] for 12 and sometimes for 24 and 48 hours. The eggs of var. *punctatus* appeared to be better able to withstand these temperatures than those of var. *pulicaris*. Exposure to 30°C. tended to shorten the duration of the egg stage and exposure to 35°C. to lengthen it. Eggs exposed to a dry atmosphere at 30 or 35°C. for 12 or 24 hours never survived.

The significance of the results in nature is discussed. As little is known of conditions in the breeding places, the discussion is largely speculative.

KETTLE (D. S.). **An Attempt to control *Culicoides impunctatus* Goetghebuer in Scotland by Barrier-spraying.**—*Ann. trop. Med. Parasit.* **43** no. 3–4 pp. 284–296, 1 pl., 2 figs., 22 refs. Liverpool, 1949.

To test whether holiday camps and similar areas in Scotland could be protected from *Culicoides impunctatus* Goetgh. by an insecticide deposit applied to a belt of vegetation round the site, two areas near Loch Lomond [*cf. R.A.E.*, B **40** 1], each measuring 80×160 yards and lying half in woodland and half in open moorland, were sprayed with DDT in June. One was treated

with an emulsified solution and the other with a wettable-powder suspension, but the rate of application on each was equivalent to 2½ lb. technical DDT per acre. The midge population was estimated throughout the season from mid-May onwards by means of three adhesive traps at different levels at each of 44 catching stations [*loc cit.*] of which 20 were within the treated areas and 24 outside. Two catching stations in each area were 40 yards from the nearest untreated vegetation and the others 20 yards from it. Over 67,000 *Culicoides* adults were taken of which 65,576 were *C. impunctatus* [*loc. cit.*], but there was no evidence of a reduction in population in the treated areas, even during the week of spraying. The possible reasons for this are discussed in detail. Since laboratory tests have shown that *C. impunctatus* is readily affected by DDT deposits and that both preparations were biologically active, the failure appears to be attributable in part to unknown features in the behaviour of the midge.

BERTRAM (D. S.). **Studies on the Transmission of Cotton Rat Filariasis. I. The Variability of the Intensities of Infection in the Individuals of the Vector, *Liponyssus bacoti*, its Causation and its Bearing on the Problem of Quantitative Transmission.**—*Ann. trop. Med. Parasit.* **43** no. 3–4 pp. 313–332, 4 figs., 25 refs. Liverpool, 1949.

The following is taken from the author's summary. A study is made on the nature of the infections obtained in *Liponyssus bacoti* (Hirst) fed on cotton rats [*Sigmodon hispidus*] infected with *Litomosoides carinii*. Mites with low infections were more numerous than those with high infections. Intensity of infection in individual mites was directly but not simply related to the infection rate (percentage of mites infected) in the series. At infection rates of less than 50, infected mites contained only a few filarial worms, mostly 1–5. At higher infection rates, there were fewer mites with 1–2 worms, mites with 3–5 worms occurred with about the same frequency as at other infection rates, and mites with 6–20 worms became progressively more frequent as the infection rate rose above 50. Above about 70, mites with 21–78 worms occurred. Below an infection rate of about 50, the mean number of worms per mite increased slowly from about 0·1 at 7 to about 1·5 at 50, but above this level the mean values increased progressively and rapidly up to as much as 13 at infection rates of over 90.

The mean number of worms per mite obtained for series with infection rates lower than 50 is a much more reliable estimate than the mean value obtained at higher rates, so that accurate quantitative transmission of the infection can best be undertaken by using series of mites with infection rates below this level. Anomalously heavy infections in individual mites of such series occurred very occasionally and were observed when the blood infections of the cotton rats used for the infecting meal were over 200 days old. It is possible that such anomalous infections may be avoided if cotton rats with blood infections of a suitable age below 200 days are used. If they are due to chance, they are uncontrollable. It might then be practicable, in certain types of investigation, to discard observations made on cotton rats found to have sustained infections greatly in excess of the statistical limits allowed for the calculated mean number of worms transmitted, this figure having been based on the lightly infected mites of a series.

Mites appear to ingest varying numbers of microfilariae, though consistently fewer than would be expected from counts of the numbers in the hosts' peripheral blood. This may be due to their tendency to feed at scarifications and at sites where other mites are already feeding, so that they may ingest blood from haemorrhagic tissue in which microfilariae may be less numerous than in undamaged capillaries.

There is some similarity between the patterns of variation of the numbers of microfilariae taken up by mites of the same series and the numbers of infective forms subsequently found in them, but the numbers ingested may greatly exceed the numbers of infective forms developed. There is evidence that some microfilariae circulating in the blood of a cotton rat cannot develop further in the vector, and that factors arising from the nature of the infection in the cotton rat, rather than factors intrinsic to the vector, are responsible for this loss of their normal viability. It is concluded that a certain critical number of microfilariae must be taken up before a mite chances to ingest normal, viable ones, and that this threshold value will vary with the cotton rat and with the state or phase of its infection. Probably, the number of normally viable microfilariae ingested, rather than an inherent and variable susceptibility to infection in individual mites, is responsible for the variation in numbers of infective forms found in mites of the same series. Mites do not appear to be adversely affected by the worm infections that they sustain.

KIRK (R.) & LEWIS (D. J.). **Taxonomy of the Ethiopian Sandflies** (*Phlebotomus*). **IV.** *P. bedfordi* **Newstead and** *P. antennatus* **Newstead.**—*Ann. trop. Med. Parasit.* **43** no. 3–4 pp. 333–336, 1 fig., 8 refs. Liverpool, 1949.

In this part of a series [*cf.* *R.A.E.*, B **40** 9, etc.], *Phlebotomus bedfordi* Newst. [**3** 11] and *P. antennatus* Newst. are re-described on the basis of examination of the type material and their relation to more recently described species is discussed. It is concluded that *P. congolensis* var. *distinctus* Thdr. [**22** 28] is a synonym of *P. bedfordi*, that *P. bedfordi* is the typical example of a small group of closely allied species including *P. yusafi* Sinton [**18** 265] and *P. schoutedeni* Adl., Thdr. & Parr. [**18** 5], and that *P. congolensis* Beq. & Walr. [**22** 6, etc.], *P. c. firmatus* Parr. & Malb. and *P. c. medius* Kirk & Lewis are varieties of it. *P. antennatus* becomes the typical example of another small group, including, in the Ethiopian Region, *P. signatipennis* Newst. [**31** 245], *P. occidentalis* Thdr. [**31** 245], *P. dubius* Parr., Morn. & Cad. [**36** 180] and *P. cinctus* Parr. & Martin [**33** 115], all of which are regarded as varieties of it. The group is widely distributed in the Old World and has representatives in the Palaearctic and Oriental Regions.

UNSWORTH (K.). **Observations on the seasonal Incidence of** *Oestrus ovis* **Infection among Goats in Nigeria.**—*Ann. trop. Med. Parasit.* **43** no. 3–4 pp. 337–340, 1 graph, 4 refs. Liverpool, 1949.

Examination of the heads of goats from the Kano area of Nigeria showed that the percentages infested by larvae of *Oestrus ovis* L. in the successive months from August 1948 to July 1949 were about 32, 42, 21, 9, 8, 4, 15, 15, 33, 64, 67 and 57. It is concluded that the adult flies are most active in May and June [*R.A.E.*, B **39** 133] and that activity at other times is slight. Mature larvae were found in small but fairly constant numbers in each month from November to May and in much larger numbers in June and July. It thus appears probable that some of the larvae deposited in the nostrils during May and June develop to maturity in 1–2 months and that others remain in the first instar for varying periods [*cf.* **24** 84] yielding a constant but comparatively small number of mature larvae during the dry season. The sudden increase in fly activity that results in the heavy infestations in May and June, is presumed to be due to retardation of pupal development during the dry season, which immediately precedes it.

DAVIDSON (G.). **A Field Study on "Gammexane" and Malaria Control in the Belgian Congo. I. The Anophelines of Yaligimba and their Bionomics.**—*Ann. trop. Med. Parasit.* **43** no. 3–4 pp. 361–372, 1 pl., 1 map, 10 refs. Liverpool, 1949.

A description is given of an oil-palm plantation and its surroundings at Yaligimba in the forest belt of the northern Belgian Congo where observations were made from September 1947 to March 1949 on the control of Anophelines by means of spray deposits of benzene hexachloride in houses. The plantation has an area of about 30 square miles, the plantation workers and their families live in the camps scattered round the periphery and comprising some 1,400 houses in all, and native villages are numerous in the neighbourhood. There are many small rivers in and near the plantation that sometimes spread to form swamps, and a large navigable river flows to the south-east of it and a smaller river to the west. The rainfall is low. Much the most prevalent species of *Anopheles* is *A. moucheti* Evans, which breeds in flowing water. Its density was found, by the use of pyrethrum sprays in closed houses, to be associated with the level of the water in the main rivers, high water providing the maximum number of marginal breeding-places [*cf. R.A.E.*, B **37** 36]. Over 33,000 females and only one male were taken. *A. gambiae* Giles was comparatively scarce, and its seasonal variation in density appeared to be associated with the length of rainy periods. It was most plentiful after two periods of heavier rainfall when rain-water pools persisted long enough for the larvae to complete development. *A. paludis* Theo. was the only other species of *Anopheles* found, and, although its larvae were common in swamps and stream edges, adults were rarely seen in houses.

Examination of the stomach and ovary conditions of female mosquitos caught by using pyrethrum sprays, window traps, trap nets and faulty bed nets, all of which methods are described, indicated that *A. moucheti* rested in houses for some time after feeding, but never long enough for the ovaries to mature completely. This takes much longer in *A. moucheti* than in *A. gambiae*. Many more mosquitos were found to enter and leave a house in a single day than actually rested in it. *A. moucheti* occurred in greatest numbers near the two large rivers. *A. gambiae* was haphazard and localised in its distribution. Malaria sporozoites were found in the glands of 0·38 per cent. of 3,927 females of *A. moucheti* from untreated villages, 3·8 per cent. of 651 females of *A. gambiae*, and none of 63 females of *A. paludis*.

ROZEBOOM (L. E.). **The Significance of *Anopheles* Species Complexes in Problems of Disease Transmission and Control.**—*J. econ. Ent.* **45** no. 2 pp. 222–226, 1 map, 10 refs. Menasha, Wis., 1952.

The fact that a given species of *Anopheles* is in general dangerous as a vector of malaria in direct proportion to its predilection for human blood and its desire to enter houses to feed and rest accounts for the great success as an anti-malaria measure of spraying with DDT to leave a toxic deposit in houses, but it would appear that there is a possible relationship between control measures and basic research on the mechanisms of evolution by which subspecies and species arise. In the genus *Anopheles*, complexes of subspecies or closely related species appear to have developed through divergence of geographically isolated populations. There is evidence of geographic replacement in the Palaearctic Region among members of the complex of *Anopheles maculipennis* Mg., although some overlapping occurs. Members of this complex with broadly overlapping ranges may have been separated at one time and have diverged to such an extent that they retained their separate identities when they again came into contact. The five North American

forms, *A. earlei* Vargas, *A. quadrimaculatus* Say, *A. maculipennis* var. *occidentalis* D. & K., *A. m. freeborni* Aitken and *A. m. aztecus* Hffm., all of which the author treats as distinct species, can be separated morphologically much more readily than can the Palaearctic forms. *A. earlei*, which has the most extensive and northerly distribution, appears to be the most closely related to the Palaearctic *A. maculipennis* var. *typicus*, and may represent a New-World extension of typical *maculipennis* that has been separated long enough for differences to develop. It will mate in small cages, whereas *typicus* will not. A. R. Barr, in cross-breeding experiments with three of the North American forms, found that mating occurs readily, but females of *A. quadrimaculatus* that had paired with males of *A. m. aztecus* or *A. m. freeborni* and *aztecus* or *freeborni* females that had paired with *quadrimaculatus* males produced eggs that were non-viable or gave rise to weakly larvae that seldom lived beyond the second instar. A hybrid male obtained from one of the *freeborni* females was the only individual that developed beyond the third instar. *A. m. aztecus* and *A. m. freeborni* are much more closely related to one another than they are to *A. quadrimaculatus*. Cross breeding between them resulted in the production of F_1 hybrid adults, but larval mortality was high. When given the choice, males of *quadrimaculatus* and, to a less extent, those of *freeborni* paired with females of their own kind rather than with those of the other. There were also differences in the responses of larvae of *A. m. aztecus*, *A. m. freeborni* and *A. quadrimaculatus* to temperature, those of the first being the most susceptible and those of the last the most resistant to high temperatures.

When populations within a species have become geographically isolated, adaptation to local ecological conditions, accompanied by natural selection, must progress constantly, affecting not only structure but also functions and behaviour. Instances are given of differences in behaviour and physiology between cryptic species or subspecies of Anophelines and also among local populations within these taxonomic units. *A. pseudopunctipennis* Theo. enters houses and feeds on man in some countries but appears to do so very rarely in others [*cf. R.A.E.*, B **30** 107, 154; **32** 183; **36** 53, etc.]. Possibly, there is enough biological plasticity within the species to allow it to take advantage of man-built structures as resting places in the more arid parts of its range, where suitable natural resting places would be comparatively few. *A. bellator* D. & K., an important vector of malaria, rests in houses in large numbers in Brazil [*cf.* **31** 237] but does not enter them readily in Trinidad [*cf.* **29** 173]. Domesticity and habitual feeding on man may be the result of adaptation of originally wild species to an environment created by man.

The great effectiveness of the lasting insecticides is due to an alteration in the mosquitos' environment. The conversion of an integral part of the niche of a domestic species into a lethal trap has caused great destruction of the dangerous species, especially of *A. darlingi* Root, but there is no proof that it will eradicate an indigenous species in a large area. In spite of several years' intensive effort against larvae and adults of *A. m. labranchiae* Flni. in Sardinia [*cf.* **38** 215, etc.], the mosquito is still found, apparently at survival level though in greatly reduced numbers. Survival is possible because a few adults either do not enter houses or, if they do, escape without sufficient contact with the insecticide to cause death. This may be a matter of chance, but it may be that these adults are responding to altered ecological conditions in a way that will lead, through adaptation and natural selection, to the development of strains more or less completely adjusted to an environment in which houses are routinely sprayed with lasting insecticides. Such strains might come to avoid houses entirely or to enter to feed only and leave with the minimum contact with walls and ceilings, as *A. bellator* does in Trinidad. There might also be a change in the site of malaria transmission from indoors to out of doors.

Hoffman (R. A.) & Lindquist (A. W.). **Absorption and Metabolism of DDT, Toxaphene and Chlordane by resistant House Flies as determined by Bioassay.**—*J. econ. Ent.* **45** no. 2 pp. 233–235, 4 refs. Menasha, Wis., 1952.

Females of a DDT-resistant strain of *Musca domestica* L. were topically treated with 10 mmg. DDT, toxaphene or chlordan in solution. They were washed externally with acetone 24 hours after treatment, by which time 91, 98 and 100 per cent., respectively, of the three groups had died. They were then macerated, and the absorbed toxicant was extracted with acetone and removed by filtration. Samples of flies treated with chlordan were similarly examined after 4 hours. The mortalities obtained by topical treatment of susceptible flies with the wash or extract were compared with those on a standard dosage-mortality curve prepared from data obtained by treating susceptible flies with known concentrations of insecticides, and the amounts on and in the resistant flies were calculated from this. The differences between 10 mmg. and the amounts of toxicant indicated for the wash alone and for the wash and extract together are, respectively, the theoretical amounts of toxicant absorbed and degraded by each fly. The results indicated that the flies absorbed 3·8 mmg. DDT, 5·4 mmg. toxaphene and 6·8 mmg. chlordan, and metabolised nearly 3·5 mmg. of the DDT, 4 mmg. of the toxaphene and 5·9 mmg. of the chlordan. The figures for DDT were comparable with those obtained by other methods [*R.A.E.*, B **38** 209 ; **39** 153]. The observations with chlordan made after 4 and 24 hours indicated that its absorption is most rapid in the first four hours. In some bioassays with chlordan, fourth-instar larvae of *Aëdes* were used as test insects instead of susceptible house-flies. They gave results essentially the same as those obtained with flies.

Lindquist (A. W.). **Radioactive Materials in entomological Research.**—*J. econ. Ent.* **45** no. 2 pp. 264–270, 25 refs. Menasha, Wis., 1952.

The author briefly outlines the principles of radioactivity, describes the four types of radiation (α-particles, β-particles, γ-rays and X-rays) most frequently encountered in biological and medical research, indicates the extent and variety of the uses of radioactive isotopes, defines the terms commonly employed in work on radioactive materials, and reviews their uses in entomological research.

Radioactive isotopes are used as tracers in studies of the distribution of various chemicals in insects [*cf. R.A.E.*, B **39** 1, 153 ; **40** 60], which may include investigations on the penetration of insect cuticle, the ways in which insecticides enter insects and are distributed in and eliminated by them, and the effects of sublethal doses. Tests on *Musca domestica* L. have shown that absorption or penetration of radioactive DDT continued after the treated insects had died, indicating that the amount absorbed should be measured soon after death to show the lethal dosage. Radioisotopes might also be used to study the physical properties of emulsions and suspensions and the distribution of sprays or dusts applied with various types of equipment. Radioactive materials are used in ecological investigations to mark insects, which are liberated and later detected with suitable apparatus [*cf.* **38** 155 ; **39** 135, 168, 181], and the possibility of controlling an insect by the release of males sterilised by X-rays [**40** 43] has been suggested.

Suggestions on the initiation of studies with radioactive materials include information on the types of equipment for detecting radioactivity that are most suitable for biological research.

Kilpatrick (J. W.) & Fay (R. W.). **DDT-resistance Studies with the Oriental Rat Flea.**—*J. econ. Ent.* **45** no. 2 pp. 284–288, 3 figs., 6 refs. Menasha, Wis., 1952.

The effect of DDT dust deposits on adults of *Xenopsylla cheopis* (Roths.) exposed for short periods of known duration was tested on individuals selected for their resistance. When the study was begun, no resistance to DDT in fleas was known to have been observed in the field, but during the summer of 1949, several reports were received of the persistence of high populations of *Ctenocephalides felis* (Bch.) after as many as three applications of 5 per cent. DDT in pyrophyllite to infested premises. The infestations were much reduced or eliminated by the use of dusts containing 5 per cent. chlordan.

Stocks of *X. cheopis* for the experiments were reared from adults fed on rats kept in individual cages over a screen tray of shavings standing on a layer of dry sterile sand and finely ground rat faeces in an enamelled plywood box. Cocoons were collected by sifting and placed in trays in a glass container, and the emerging adults were collected daily with an aspirator. A description is given of the method used for applying dust deposits of known weight to cardboard disks and subsequently exposing the fleas to the deposit. This was done by pouring the fleas down a glass tube standing over the treated disk in a jar, so that they were in constant contact with the deposit except when jumping. After the desired exposure, the disk was removed from the jar and the fleas left for 24 hours. Those surviving at the end of this time in tests showing a suitable mortality were used to start colonies for the next generation. Under the selection exerted by exposure for four minutes to a dust of 5 per cent. DDT in pyrophyllite applied at 50 mg. per sq. ft., increasing resistance to DDT was shown by the fleas through the F_3 generation, mortality decreasing from 65 per cent. in the parent generation to 32 per cent. in F_3. No further increase in resistance was shown in tests through the F_7 generation, even under selection by exposure for eight minutes. The degree of resistance shown by the laboratory strain of *X. cheopis* was not considered to be of economic importance to field control programmes.

Fay (R. W.), Stenburg (R. L.) & Ernst (A. H.). **A Device for recording insecticidal Knockdown of House Flies and evaluating residual Deposits.**—*J. econ. Ent.* **45** no. 2 pp. 288–292, 6 figs., 3 refs. Menasha, Wis., 1952.

An apparatus is described for making a continuous record of the knockdown of house-flies [*Musca domestica* L.] effected by an insecticide deposit in a cage ; each fly that falls is trapped between two pieces of adhesive cellulose tape as they are wound into a double ribbon on a reel. The rate of tape movement, which varies with the amount of tape on the reel, is shown by placing markers on the outside at regular intervals of time. The progress of knockdown can be seen at the end of the exposure period or the tapes may be stored in a refrigerator for later study. A double-cage recorder allows two tests to be made simultaneously for comparison.

The recorder was used to compare the rates of knockdown given at 80°F. and 70 per cent. relative humidity by various insecticides applied at 200 mg. per sq. ft., and the rates are shown by graphs. Pyrethrum, benzene hexachloride (30 per cent. γ isomer), DDT, methoxy-DDT (methoxychlor), "Q-137" (1,1-bis(p-ethoxyphenyl)-2,2-dichloroethane), fluoro-DDT (1,1-bis(p-fluorophenyl)-2,2,2-trichloroethane), aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], chlordan, DDD (1,1-bis(p-chlorophenyl)-2,2-dichloroethane) and toxaphene showed a progressive decrease in knockdown activity

in the order mentioned. Fluctuations between replicates and differences between the time needed for a given knockdown of male and female flies were greater for the insecticides that acted more slowly. Chemicals related to DDT tended to begin to show knockdown activity after 10–30 minutes, and those related to aldrin and chlordan after 30–90 minutes.

DeLong (D. M.), Boush (G. M.) & Lea (A. O.). **The comparative residual Toxicity of Fog Applications of certain organic Insecticides to House Flies.**—*J. econ. Ent.* **45** no. 2 pp. 323–325. Menasha, Wis., 1952.

Tests were made during 1950 and 1951 to determine the relative effectiveness against house-flies [*Musca domestica* L.] of deposits obtained by fog applications of chlorinated-hydrocarbon insecticides. The turbine generator used broke the liquid into droplets measuring 10–20 μ, which floated in the air for 0·5–3 hours. The best droplet size was obtained when the rate of dispersion was about 1 U.S. pint in 3–4 minutes. In the experiments made in 1950, 3 per cent. chlordan, 5 per cent. DDT and 2 per cent. lindane [containing at least 99 per cent. γ benzene hexachloride] all gave 95–100 per cent. kill within 36 hours of female flies liberated in rooms with a capacity of 1,450 cu. ft. that had been treated 90 days before with 4 oz. liquid each to form a deposit of less than 7 mg. per sq. ft. surface.

The tests in 1951 were made by dispersing 2·5 oz. liquid in rooms with a capacity of 1,200 cu. ft. so that a deposit of 6·5 mg. or less per sq. ft. surface was left, or 10 oz. liquid in rooms with a capacity of 5,400 cu. ft., leaving a deposit not exceeding 7·5 mg. (average 5·6 mg.) per sq. ft. The rooms remained closed in all tests. Dilan [a 2 : 1 mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane] at a dilution of 1 : 400 was the least effective insecticide tested in both series and chlordan at 7 per cent. the most effective, the latter giving complete or nearly complete kill for more than 60 days. Good results for about 50 days were given by chlordan at 3 per cent. Lindane at 2 per cent. was nearly as effective as chlordan at 3 per cent. for over 60 days in one series and for about 30 days in the other, after which it lost effectiveness. Methoxy-DDT (methoxychlor) at 8 per cent. was superior to lindane at 2 per cent. and about equal to DDT at 5 per cent. in one series and inferior to lindane but superior to DDT in the other.

The high toxicities of chlordan and lindane are attributed to their volatility. The first indication of high volatility was obtained when all the flies in a cage placed about 2 ft. from the wall of a room that had been fogged a few days previously with chlordan died in a few hours with typical symptoms of chlordan poisoning. Comparative tests of volatility made by suspending cages of flies from the ceiling 1–5 ft. from treated walls indicated that chlordan was the most volatile of the insecticides used on the basis of toxicity under these conditions. It gave complete mortality within 20 hours of flies exposed 40 days after treatment 5 ft. from the wall and within 48 hours of flies exposed 110 days after treatment 1 ft. from the wall. Lindane was the next most toxic. Complete mortality within 16 hours resulted from exposure 1 ft. from a wall treated 8 days earlier with 2 per cent. lindane or 3 per cent. chlordan. Both 8 per cent. methoxy-DDT and 7 per cent. DDT gave 48 per cent. mortality in 24 hours. Dilan (1 : 400) and 3·5 per cent. DDT were ineffective.

Observations over three years in more than 300 large commercial buildings treated while in normal use showed that flies, of which three species were principally involved, can be effectively controlled for 1–3 months according to the nature of wall and ceiling, uniformity and completeness of coverage, and the extent to which the deposit is removed or obscured.

ROGOFF (W. M.) & MOXON (A. L.). **Cable Type Back Rubbers for Horn Fly Control on Cattle.**—*J. econ. Ent.* **45** no. 2 pp. 329–334, 1 fig., 7 refs. Menasha, Wis., 1952.

A description is given of a cable-type back rubber, which has given highly effective control of *Siphona irritans* (L.) on cattle under range conditions in South Dakota over several years, for a low cost and a minimum of trouble and without interfering with grazing. The rubber consists of a cable wrapped in burlap sacking and suspended between two fence posts about 16 ft. apart, so as to sag to within about 18 ins. of the ground. The sacking is periodically soaked in insecticide. The rubber is installed near a drinking place, salt lick or other site frequented by the cattle, which readily used it without coercion of any kind. Of various insecticides tested, a 5 per cent. solution of DDT appeared to give the best results. Treatment was originally made with 1 U.S. gal. solution and repeated at intervals of about two weeks with half that quantity. A rubber so treated and a 0·5 per cent. DDT spray both gave highly effective control of *S. irritans* over an observation period of 24 days, and no significant difference was apparent between them in effectiveness against *Stomoxys calcitrans* (L.), though control was less complete. Emulsion concentrates diluted with furnace oil gave good results but were subject to leaching in rain, whereas solutions were not. Chemical analysis of burlap from a rubber charged eight times during one season showed it to contain 5·9 mg. DDT per gm. This suggests that when the burlap has been treated a few times, the occasional addition of solvent might be sufficient to recharge it.

No significant skin irritation was seen over a period of two years in animals using back rubbers. DDT deposits in fat of cattle using the rubbers for a whole season averaged 1·8 parts per million with a maximum of 5·2 p.p.m. Deposits in the fat of animals sprayed three times with 0·5 per cent. DDT suspension averaged 14·9 p.p.m.

KNUTSON (H.) & SZYMKOWICZ (R. T.). **Ectoparasitism of Norway Rats in an Inland New England Village and in a New England Seaport.**—*J. econ. Ent.* **45** no. 2 pp. 338–339, 2 refs. Menasha, Wis., 1952.

A comparison is made between the ectoparasites found on rats (*Rattus norvegicus*) trapped alive between 12th October and 2nd May 1951 in a small inland village in Rhode Island and those found on rats examined in a large seaport (Providence) in the same State in 1913 [*R.A.E.*, B **1** 186]. *Xenopsylla cheopis* (Roths.), which had formed 75 per cent. of the fleas on the rats in the port, was absent from the village collections, where 85 per cent. of the fleas were *Nosopsyllus fasciatus* (Bosc), and the remaining 15 per cent. *Ctenophthalmus pseudagyrtes* Baker, a mole flea. *Haemolaelaps* (*Atricholaelaps*) *glasgowi* (Ewing) constituted 93 per cent. of the mites on the village rats and *Eulaelaps stabularis* (Koch) the remaining 7 per cent., whereas virtually all the mites on the seaport rats were *Echinolaelaps echidninus* (Berl.). *Polyplax spinulosa* (Burm.) was the only louse in both collections. Data on numbers of the chief species per rat and per infested rat, combinations of the various species on individual hosts and maximum collections on a single host are given for the 1951 study.

MALLIS (A.), MILLER (A. C.) & SHARPLESS (R. V.). **Effectiveness against House Flies of six Pyrethrum Synergists alone and in Combination with Piperonyl Butoxide.**—*J. econ. Ent.* **45** no. 2 pp. 341–343, 2 refs. Menasha, Wis., 1952.

The results are given of tests carried out to determine whether a combination of technical piperonyl butoxide and another synergist would increase the

toxicity of pyrethrins to house-flies [*Musca domestica* L.] more than either synergist alone. All the sprays contained 50 mg. pyrethrins per 100 ml., and the synergists were added singly at concentrations that resulted in 50–70 per cent. mortality or together at half these concentrations. The additional synergists tested were 264 (a technical product containing 98 per cent. n-octyl bicycloheptene dicarboximide), n-octyl sulphoxide of isosafrole, n-propyl isome, sesame oil extractives, isobutyl undecyleneamide and piperonyl cyclonene. It is concluded from the results that the combinations showed, for the most part, only an additive effect. There was no evidence of inhibition or hyper-synergism of economic importance. Piperonyl butoxide, n-octyl sulphoxide of isosafrole and piperonyl cyclonene on a weight basis were the most effective synergists in the tests.

Roth (L. M.) & Willis (E. R.). **Method for isolating Males and Females in Laboratory Colonies of** *Aëdes aegypti*.—*J. econ. Ent.* **45** no. 2 pp. 344–345, 1 fig., 3 refs. Menasha, Wis., 1952.

To separate males from females in laboratory cultures of *Aëdes aegypti* (L.), adults are allowed to emerge in cages measuring $9 \times 10 \times 13$ ins., and the males are then concentrated by making use of their response to certain sound frequencies. The cage is jarred to induce flight, and a vibrating tuning fork of the appropriate frequency (320–512 vibrations per second) is held near the outside. The males are attracted in numbers to the source of the sound, seize the cloth of the cage and vibrate their wings. During this response, while they are concentrated in a relatively small area and are clinging to the side of the cage, they are readily removed with a venturi-type aspirator. By repeating the process, numbers can be collected and transferred to separate cages in a short time. It is not known to what extent the procedure may be applicable to other species of mosquitos.

Manefield (T.). **Investigations of the Preferences shown by** *Aëdes* (*Stegomyia*) *aegypti* **Linn. and** *Culex* (*Culex*) *fatigans* **Wied. for specific Types of Breeding Water.**—*Proc. Linn. Soc. N. S. W.* **76** pt. 3–4 pp. 149–154, 11 refs. Sydney, 1951.

Experiments on the reactions of *Aëdes aegypti* (L.) and *Culex pipiens* var. *fatigans* Wied. to tap water (0·0062 per cent. dissolved salts) and foul water for oviposition and the ability of larvae to develop to the mature pupal stage when kept in these types of water and given food are described. A laboratory stock of *A. aegypti* and a stock of *C. p. fatigans* collected at Sydney were used. The foul media were infusions prepared by mixing approximately equal parts by volume of dried horse manure and water and allowing the mixtures to stand for seven, 10–11 or 14–15 days. When given the choice between tap water and infusions that had matured for ten days or more, females of *A. aegypti* laid 82·3 per cent. of 29,905 eggs in the foul water, and those of *C. p. fatigans* laid many eggs on the foul water and none on the tap water. The percentages of individuals of *A. aegypti* that developed in seven-day infusions were 70, 38 and 0 when larvae were introduced in the third, second and first instars, respectively, and 4 when introduction was in the egg stage. The corresponding percentages were 88, 74, 58 and 44 for ten-day infusions, 98, 98, 94 and 94 for 14-day infusions, and 99, 99, 96 and 99 for tap-water controls. Scum formation affected survival in the seven- and ten-day infusions, and mortality was reduced in all cases by removing the scum. Its effect was most noticeable when eggs or first-instar larvae were introduced into ten-day infusions. The percentages surviving in these two cases increased to 90 and 82, respectively, when the

scum was removed. For comparison between the two mosquitos, larvae were introduced into the medium in the first instar. The survival percentages for *A. aegypti* and *C. p. fatigans* were 3 and 62 in seven-day infusions with the scum untouched, 5 and 74 in similar infusions with the scum removed, 60 and 92 in 11-day infusions with the scum untouched and 84 and 96 in 11-day infusions with the scum removed.

HODGKIN (E. P.). **On the Dissection of Mosquitoes for Malaria Parasites and the Information to be derived therefrom.**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 6 pp. 617–634, 1 fig., 9 refs. London, 1950.

The object of this paper is to show that published oöcyst and sporozoite rates often fail to indicate the importance of individual species of *Anopheles* as vectors of malaria in nature because of defects in the technique of collecting or examining the mosquitos, and particularly that infection rates estimated from mosquitos dissected several days after they are caught are invalid. These conclusions are supported by examples from the author's investigations in Malaya between 1931 and 1941, and the effect of delay in dissection is illustrated by a hypothetical example in which it is assumed that all mosquitos of a batch had fed once on infective gametocyte-carriers, that 50, 25, 12·5 and 12·5 per cent., respectively, had done so on the date of capture and 4, 8 and 12 days before, that oöcysts and sporozoites appear in 4 and 12 days, and that all mosquitos survive until the date of dissection. It is evident that the sporozoite rates (percentages) would be 12·5 if the mosquitos were dissected on the date of capture and 25, 50 and 100 if they were dissected 4, 8 and 12 days later. The respective oöcyst rates would be 37·5, 75, 50 and 0.

Sporozoite rates on the date of capture show the importance of the mosquitos as vectors ; other rates do not, because they fail to show the percentages that would survive to develop sporozoites in nature, and delay in dissection may incriminate a species as a vector of malaria on false evidence. Of nearly 4,000 females of *Anopheles karwari* (James) dissected from an estate where *A. maculatus* Theo. was also present in large numbers, two showed oöcysts and two showed sporozoites, but all these four had been kept for 7–9 days before dissection. This is the only published record of infections having been found in females of *A. karwari* taken in nature, and there is no epidemiological evidence that it is a vector. Sporozoite rates in *A. maculatus* on the same estate were more than doubled when the mosquitos were kept for four days or more before dissection. During investigations on *A. barbirostris* Wulp in Perak [*R.A.E.*, B **25** 68], the total sporozoite rates were higher in 1933 than in 1934, but the rates in mosquitos dissected within three days were 0 and 0·5, the latter rate being the only one to provide positive evidence that *A. barbirostris* was a vector. It is further stated that subsequent investigations have shown the existence of two forms of *A. barbirostris* in Malaya, that of these one is a vector while the other is probably harmless [**34** 32] and that both forms were caught on the estate in question.

Inadequate collection technique may prevent the recognition of the true vector in a given locality if it is relatively rare or wild in its habits [*cf.* **36** 203], particularly if other species are abundant and come to be regarded as the vectors because they feed on man often enough for infections to be found in them when they are kept for several days before dissection.

Even if other precautions are taken, the sporozoite rate is of little value in assessing the part played by a particular species in transmission or the risk to which man is exposed unless the approximate numbers of this species that will bite an individual in a given period is known [*cf.* **21** 131]. This is best ascertained in Malaya by using a human bait trap. Examples are given of data on transmission by Malayan Anophelines calculated in this way.

Kumm (H. W.). **Seasonal Variations in Rainfall : Prevalence of *Haemagogus* and Incidence of Jungle Yellow Fever in Brazil and Colombia.**—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 6 pp. 673–682, 2 maps, 1 graph, 5 refs. London, 1950.

Data based on records for periods varying from five to 31 years are given on the rainfall of Colombia, the heavily forested areas of Brazil (Amazon valley and Ilhéus) and the remaining and more sparsely forested areas of Brazil ; and the relationship of rainfall to the incidence of jungle yellow-fever in man is examined for the three regions and to the prevalence of mosquitos of the genus *Haemagogus* as recorded in the literature for the first and last. In heavily forested Brazil, rainfall is heaviest from January to May with a peak in March. A few cases of yellow fever have been found each year since 1932 ; they have occurred at all times of the year, with peaks of prevalence in January, May and July. The higher incidence from May to August than at other times may be partly due to greater exposure of the population to *Haemagogus* during the brazil-nut harvest, particularly as the nuts are sometimes gathered from the forest canopy. In Colombia, where climatic conditions in the affected areas are similar to those in the Amazon forests, rainfall rises to a peak in May, and this is followed by a high prevalence of *Haemagogus* in June and the first peak in yellow-fever incidence in July. During the period 1934–47, 468 liver specimens positive for yellow fever were seen, cases occurring throughout most of the year. There was a second peak in December and January that was not preceded by a rise in the numbers of *Haemagogus*. It has been suggested that this may be attributed to the habit of cutting down forest in November and December. In the remainder of Brazil, there was an epidemic from 1934 to 1940 and a second in 1944 and 1945, both involving the months November to June. For at least four months (May–August), rainfall almost ceases, atmospheric temperature falls and catches of *Haemagogus* become insignificant. Rainfall is heaviest in December, *Haemagogus* is most prevalent in January and the incidence of yellow fever is greatest in February.

It is stated in conclusion that the whole region studied is characterised by wandering epizootics of yellow fever among monkeys with occasional cases in man. Outbreaks in man recur more frequently in the part of Brazil covered by Amazonian rain-forest than they do in the less forested parts, but it would be wrong to consider that there are any particular areas of permanent endemicity.

Jenkins (D. W.) & Hassett (C. C.). **Dispersal and Flight Range of subarctic Mosquitoes marked with Radiophosphorus.**—*Canad. J. Zool.* **29** no. 3 pp. 178–187, 2 pls., 2 figs., 12 refs. Ottawa, 1951.

The following is mainly based on the authors' summary. The dispersal and flight range of *Aëdes communis* (Deg.), a mosquito characteristic of the northern coniferous forest, were studied at the timberline at Churchill, Manitoba, during the summer of 1950. Four million larvae were collected and reared in four shallow wooden tanks containing a total of 1,200 litres water, and radioactive phosphorus in the form of a solution of $KH_2P^{32}O_4$ was added at a total rate of 206·3 millicuries P^{32} (0·05 microcurie per larva) as soon as the larvae reached the late fourth instar. About three million adults with an average radioactivity of 775 c.p.m. emerged and dispersed in the Warkworth area. Of the 141 radioactive mosquitos recovered in the course of six weeks, 63 had dispersed 150–5,000 ft., the average dispersal being 500 ft. A possible variable results from the presumed occurrence of two races of *A. communis* in the Churchill area [*R.A.E.*, B **39** 42] ; the larger adults dispersed further than

the more numerous smaller ones. The effective dispersal (dispersal in numbers sufficient to constitute a pest) was determined to be about a quarter of a mile. This study indicates that *A. communis* is a relatively sedentary mosquito and has a limited flight range in the northern coniferous forest in comparison with arctic tundra species. It rests in vegetation and does not attack man during the daytime. Additional data are given on the habits of this and other northern species of mosquitos.

MILLER (L. A.). **Observations on the Bionomics of some northern Species of Tabanidae (Diptera).**—*Canad. J. Zool.* **29** no. 3 pp. 240–263, 2 pls., 5 figs., 22 refs. Ottawa, 1951.

The following is based on the author's summary. Sixteen species of Tabanids are recorded (three for the first time) from the area of Churchill, Manitoba. It is established that Tabanids in this region overwinter in the larval stage and that most species have at least a three-year life cycle. Problems of taxonomy are discussed. Methods of rearing the immature stages, of collecting adults emerging in the field, of estimating larval and adult populations, and of correlating adult activity and weather conditions are described, and the results are presented. Larvae of the Tipulid, *Prionocera dimidiata* (Lw.) are reported as predators of larvae of *Chrysops* spp. The emergence of the Pteromalid parasite, *Diglochis occidentalis* (Ashm.), from pupae of *Tabanus* and *Chrysops* spp. reared from the larval stage is recorded.

SACKTOR (B.). **Some Aspects of respiratory Metabolism during Metamorphosis of normal and DDT-resistant House Flies,** *Musca domestica* **L.**—*Biol. Bull.* **100** no. 3 pp. 229–243, 5 graphs, 54 refs. Lancaster, Pa., 1951.

The respiratory metabolism of two strains of *Musca domestica* L., one of them resistant to DDT, was investigated to ascertain some of the biochemical events associated with developmental processes and to contribute to knowledge of the mechanism of insect resistance to insecticides. As cytochrome oxidase is inhibited by both DDT [*cf. R.A.E.*, B **39** 118] and cyanide (HCN), the effects of cyanide on normal and DDT-resistant strains were compared. Pupae were used because their oxygen consumption could be measured without interference with bodily activity, and because they provide an opportunity for gaining a better understanding of biochemical events during metamorphosis.

The following is based on the author's summary of the findings. Oxygen consumption follows a U-shaped curve during metamorphosis of both normal and DDT-resistant strains, and it is of the same order of magnitude in both strains. Cytochrome oxidase activity during metamorphosis also follows a U-shaped curve. There is evidence that changes in oxygen consumption during this process are, in some respects, related to the activity of the oxidase. A cyanide-insensitive system, possibly flavin, and another cyanide-sensitive system, probably tyrosinase, contribute to the total oxygen consumption. The latter system apparently contributes mainly during the early stages of metamorphosis. The cyanide-insensitive respiration of both strains remains relatively constant throughout development. The resistant strain has twice the cyanide-insensitive respiration of the normal strain.

The pupae of the DDT-resistant strain have less cytochrome oxidase activity than normal pupae at all stages except immediately before the emergence of the adult. The pupae of the DDT-resistant strain show resistance to cyanide. The effects of cyanide vary, depending on the developmental stage of the pupae. A given concentration of the inhibitor produces different degrees of inhibition and mortality in pupae of different age. One possible explanation may be a

change in the substrate being metabolised. Other possibilities are mentioned. The possible mechanisms of resistance of pupae to cyanide are discussed. These may be a by-pass of the cytochrome system, a difference in reversibility of enzyme-inhibitor complex, or a detoxification of inhibitor. It is suggested that DDT-resistance may depend, in part, on similar factors.

[Olenev (N. O.).] **Оленев (Н. О.). New Data on the Effect of Poisons from higher Plants on Ticks and Insects.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N. S.) **75** no. 1 pp. 149–151, 4 refs. Moscow, 1950.

An account is given of further tests in the Soviet Union on the toxicity to ticks and insects of the volatile fractions from various plants [*cf. R.A.E.*, B **40** 121]. The plant parts were collected in winter (February or early March) or spring (May or early June), finely ground, and used at the rate of 1 gm. to 60 cc. space. The technique was the same, except that mosquito larvae and pupae were in water in watch-glasses in the petri dishes. In the winter tests, buds of *Prunus padus* (*Padus racemosa*) killed larvae of *Ixodes persulcatus* Schulze, *Dermacentor pictus* (Herm.) and *Hyalomma asiaticum* Schulze & Schlottke in 10–12 minutes, and the bark killed adults of *Musca domestica* L. and *Cimex lectularius* L. in 1 and 3–5 minutes, larvae of *H. asiaticum* and *D. pictus* and nymphs of *I. ricinus* (L.) in 10–15 minutes, and adult females of *I. ricinus* in 25–30 minutes. The leaves of *Prunus laurocerasus* (*Laurocerasus officinalis*) and *Thuja occidentalis* killed adults of *M. domestica* in 1 and 120 minutes, respectively.

In the spring tests, the leaves of *P. padus* killed larvae and male and female adults of *I. ricinus* in 7–10, 10–15 and 25–30 minutes, respectively, and adults of *Anopheles maculipennis* Mg. and *Drosophila funebris* (F.) in 1 minute, the bark killed larvae and pupae of *A. maculipennis* in 10–15 minutes and adults of *Aëdes punctor* (Kby.) in 1 minute, and the flowers killed adult males and females of *I. ricinus* in 10–15 and 25–30 minutes, respectively. The flowers of *P.* (*Padus*) *maackii* killed adults of *A. punctor* and *C. lectularius* in 1 and 3 minutes and adult males and females of *I. ricinus* in 7–10 and 25–30 minutes, and the bark killed adults of *A. punctor* in 1 minute. Leaves of *P. laurocerasus* killed males and females of *I. ricinus* in 10–15 and 20 minutes, adults of *M. domestica* and *Anopheles maculipennis* in 1 minute and pupae of *A. maculipennis* in 10 minutes. Leaves of *Eucalyptus botryoides* and *E. paniculata* killed adults of *Aëdes punctor* in 20 minutes.

Similar tests with *Abies sibirica, Pinus sylvestris, Betula verrucosa, Caragana arborescens, Ribes nigrum, Acer platanoides* and *Daphne mezereum* were negative.

Papers noticed by Title only.

Oldroyd (H.). **The Horse-flies (Diptera : Tabanidae) of the Ethiopian Region. Volume I.** *Haematopota* **and** *Hippocentrum*.—10×7½ ins., ix+226 pp., 318 figs. (incl. frontis. & 25 pls.), 15 maps, 3 pp. refs. London, Brit. Mus. (Nat. Hist.), 1952. Price 40*s*.

Thomson (R. C. Muirhead-). **DDT and Gammexane** [benzene hexachloride] **as residual Insecticides against** *Anopheles gambiae* **in African Houses** [in Tanganyika].—*Trans. R. Soc. trop. Med. Hyg.* **43** no. 4 pp. 401–412, 2 figs., 6 refs. London, 1950. [For briefer account see *R.A.E.*, B **39** 187.]

HUEBNER (R. J.), JELLISON (W. L.), BECK (M. D.), PARKER (R. R.) & SHEPARD (C. C.). **Q Fever Studies in southern California. I. Recovery of *Rickettsia burneti* from raw Milk.**—*Publ. Hlth Rep.* **63** no. 7 pp. 214–222, 3 refs. Washington, D.C., 1948.

BECK (M. D.), BELL (J. A.), SHAW (E. W.) & HUEBNER (R. J.). **II. An epidemiological Study of 300 Cases.**—*Op. cit.* **64** no. 2 pp. 41–56, 1 map, 23 refs. 1949.

HUEBNER (R. J.), JELLISON (W. L.), BECK (M. D.) & WILCOX (F. P.). **III. Effects of Pasteurization on Survival of *C. burneti* in naturally infected Milk.**—*T.c.* no. 16 pp. 499–511, 4 refs.

JELLISON (W. L.), BELL (E. J.), HUEBNER (R. J.), PARKER (R. R.) & WELSH (H. H.). **IV. Occurrence of *Coxiella burneti* in the Spinose Ear Tick, *Otobius megnini*.**—*Op. cit.* **63** no. 46 pp. 1483–1489, 13 refs. 1948.

JELLISON (W. L.), ORMSBEE (R.), BECK (M. D.), HUEBNER (R. J.), PARKER (R. R.) & BELL (E. J.). **V. Natural Infection in a Dairy Cow.**—*T.c.* no. 50 pp. 1611–1618, 3 refs.

JELLISON (W. L.), HUEBNER (R. J.), BECK (M. D.), PARKER (R. R.) & BELL (E. J.). **VIII. Recovery of *Coxiella burneti* from Butter made from naturally infected and unpasteurized Milk.**—*T.c.* no. 53 pp. 1712–1713, 4 refs.

LUOTO (L.) & HUEBNER (R. J.). **IX. Isolation of Q Fever Organisms from parturient Placentas of naturally infected Dairy Cows.**—*Op. cit.* **65** no. 16 pp. 541–544, 7 refs. 1950.

JELLISON (W. L.), WELSH (H. H.), ELSON (B. E.) & HUEBNER (R. J.). **XI. Recovery of *Coxiella burnetii* from Milk of Sheep.**—*T.c.* no. 12 pp. 395–399, 4 refs.

LUOTO (L.), HUEBNER (R. J.) & STOENNER (H. G.). **XII. Aureomycin Treatment of Dairy Cattle naturally infected with *Coxiella burnetii*.**—*Op. cit.* **66** no. 7 pp. 199–204, 11 refs. 1951.

These are nine papers of a series of at least twelve that have not been published in the order in which they are numbered. Their contents are indicated by their titles. The recovery of *Rickettsia* (*Coxiella*) *burneti* (*diaporica*), the causal agent of Q fever, from *Otobius megnini* (Dugès) collected on dairy cattle in southern California is recorded in the fourth paper, but it is pointed out that, as this tick completes its development on one host animal, transovarian transmission, which has not yet been demonstrated in it, would seem to be essential if it is a vector of the disease.

It is stated in the second paper that 300 cases of Q fever in man in and near Los Angeles County were investigated in 1947–48. The cases, of which three were fatal, had occurred throughout the area at all seasons and over several years. They were predominantly in males in the industrial age groups, but the occupations of the people affected were extremely varied. The case distributions and histories suggest that the disease is acquired from contact with some natural source of infection in the environment. The fact that *R. burneti* has been cultivated only in the presence of living cells indicates the existence of a vertebrate or arthropod reservoir, but direct human contact with an animal source of infection would not appear to be essential, since *R. burneti* has shown considerable resistance to physical and chemical agents. Its occurrence in the blood stream of people suffering from the disease, the fact that other rickettsial diseases are transmitted by blood-sucking arthropods and the finding of *R. burneti* occurring naturally in *O. megnini* and four other species of ticks [*R.A.E.*, B **28** 227, 230 ; **32** 143 ; *cf.* also **38** 221 ; **39** 195] would seem to indicate a blood-sucking arthropod as a likely source of infection. Moreover, *Dermacentor occidentalis* Marx, as well as *O. megnini*, has been found naturally

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infected in the area under consideration. However, *D. occidentalis* occurs in the hills remote from centres of population, *O. megnini* rarely bites man, and very few patients had visited the hills shortly before the onset of illness or had any recollection of having been bitten. Where there was a history of an arthropod bite, there was no constant relation between the time when the bite was received and the onset of illness. Furthermore, the distribution of cases by age, sex, occupation and season was inconsistent with an arthropod-bite as an important source of human infection. In general, the epidemiological findings suggest occupation in the dairy or livestock industries, residence near a dairy or livestock yards and household use of raw milk as the modes of spread in southern California. No one of these would account for more than half of the cases.

Smith (A. G.) & Harrison (R. A.). **Notes on Laboratory Breeding of the Housefly** (*Musca domestica* **L.**).—*N. Z. J. Sci. Tech.* **33** (B) no. 1 pp. 1–4, 1 fig., 3 refs. Wellington, N.Z., 1951.

In the modifications here described of a method used in New Zealand for rearing *Musca domestica* L. [*R.A.E.*, B **38** 174], hessian moistened with the food used for the adults and folded longitudinally in the tube is substituted for cotton-wool as the oviposition medium. The flies in the breeding cage have uninterrupted access to a feeding tube and the oviposition tube serves solely to collect the eggs. Enough eggs of uniform age to start four cultures can be obtained in this way in 3–6 hours from a cage containing about 800 flies, and the eggs are more readily collected than from cotton-wool. The second modification is the substitution of sawdust for cotton-wool in the pupation dish, as the larvae sometimes pupated in the cotton-wool instead of beneath it, and separation was difficult.

The new method enabled over 90 per cent. of the pupae to be recovered from the petri dish, and only these were used. Observations are recorded on the life-histories of flies of the DDT-resistant line G [*cf.* **40** 92, 116] and the susceptible line A when reared by this method ; the percentages of females obtained were about 38·4 in line A and 29 in line G, and the peak of emergence was somewhat later in line G. An increase in the number of eggs seeded resulted in smaller pupae and a prolongation of the life-cycle.

Parrot (L.). **Notes sur les phlébotomes. LXI. A propos de classification.**—*Arch. Inst. Pasteur Algérie* **29** no. 1 pp. 28–45, 37 refs. Algiers, 1951.

The classification of the genus *Phlebotomus* is very fully reviewed from the literature, which culminates with Theodor's revision [*R.A.E.*, B **36** 133]. The author considers that, in spite of Theodor's proposals, the difficulty of finding morphological characters on which to build a valid and stable classification remains, to a great extent because of the difficulty of satisfactorily incorporating the abundant and largely unstudied New-World material into the chosen system. Because of the plasticity of the group, which appears to be in a state of evolution, he thinks that the simplest possible classification should be aimed at and concludes that the genus *Phlebotomus* should be retained in the wide sense to include the four genera recognised by Theodor and should have two Old-World subgenera, *Phlebotomus* and *Prophlebotomus*. Many instances are given of unsatisfactory results from Theodor's use of numerous subgenera. *Prophlebotomus*, of which the type is *P. minutus* Rond., is stated not to be a synonym of *Sergentomyia*, as the description of *Sergentomyia* [*cf.* **9** 22] was accompanied by a figure undoubtedly representing the genitalia of *P. perniciosus* Newst., which is thus the type of it, and França was unjustified in later designating *P. minutus* as the type.

The difficulties of correlating the classification of the American species of *Phlebotomus* with that of the Old-World species are discussed, and it is concluded that a general classification for the group throughout the world is desirable.

It is stated in a footnote that the name *pungens* Parr., which was given to a variety of *P. schoutedeni* Adl., Thdr. & Parr. in the first part of a paper already noticed [**39** 17], is preoccupied by that of *P. pungens* (Lw.), a species found in fossil resin, and the new name *nocens* is therefore proposed for the variety.

Berck (B.) & Smallman (B. N.). **Absorption and Efflorescence of DDT deposited on Wood.**—*Soap & sanit. Chem.* **28** no. 4 pp. 131–133, 6 refs. New York, N.Y., 1952.

The following is mainly based on the authors' summary. Plywood panels were sprayed with 5 per cent. DDT in an oil solution, wettable-powder suspension or emulsified solution under conditions that gave a deposit of about 125 mg. DDT per sq. ft., and chemical measurements were made of the amounts of DDT recovered one day and 45 days later by stripping the panels with benzene by a method that was shown to recover the DDT mainly from the free surface and the surface layer of wood to a depth of 0·001 inch. Recoveries one day after treatment showed losses of 47·8, 40·9 and 33 per cent. of applied DDT for solution, suspension and emulsified solution, respectively. The losses observed for the solution and the emulsified solution are attributed to absorption by the wood, but the loss indicated for the suspension is attributed to incomplete recovery from the surface, the probable explanation being that some of the water carrier had not evaporated and so prevented the benzene from reaching some of the DDT particles.

Recoveries 45 days after treatment showed consistent increases over the quantities recoverable after one day, the increases amounting to 22·8, 37·6 and 19·4 per cent. for solution, suspension and emulsified solution, respectively. The increased recoveries observed for the solution and the emulsified solution are attributed to the efflorescence of DDT from a supersaturated solution within the wood to a crystalline deposit at the surface, but the increased recovery indicated for the suspension is considered to be due to recovery of DDT that had been on the surface but unavailable to the stripping solvent on the first day. At the stripping 45 days after application, 80 per cent. of the DDT applied in the emulsified solution and suspension and 64 per cent. of the DDT applied in oil solution were recovered from the surface of the wood.

Reichenow (E.), Vogel (H.) & Weyer (F.). **Leitfaden zur Untersuchung der tierischen Parasiten des Menschen und der Haustiere.** [Guide to the Investigation of the Animal Parasites of Man and Domestic Animals.]—3rd revd. edn., viii+297 pp., 101 figs., 12 pp. refs. Leipzig. J. A. Barth, 1952. Price bound *DM.* 30.60 ; unbound *DM.* 28.20.

This text-book for students is divided into three parts, of which the first, by Reichenow, and the second, by Vogel, deal with protozoa and worms, respectively. Both contain references to arthropods as vectors or hosts where appropriate. The third part (pp. 191–275) is by Weyer and deals with arthropods. It consists of a section on the medical and veterinary importance of arthropods, another on general laboratory methods of preservation, breeding, the preparation of specimens and anatomical and histological investigations, and a third in which the various groups of arthropods concerned are considered separately. These comprise groups that are themselves parasitic on man or domestic animals and groups of which the members transmit pathogenic organisms,

and the information given on them includes methods of obtaining material, breeding, preservation, identification, the demonstration of infection and the establishment of artificial laboratory infections. The examples selected for discussion are chosen for general availability to students and close relation to rare or exotic forms.

WEISSENRIEDER (F. X.). **Neue Wege in der Bekämpfung der Dasselplage.** [New Methods in the Control of Warble-flies.]—*Landw. Jb. Schweiz* **64** pt. 2–3 pp. 297–310, 3 graphs. Berne, 1950. (With a Summary in French.)

Although treatment of cattle infested by *Hypoderma bovis* (Deg.) and *H. lineatum* (Villers) was made compulsory in Switzerland in 1944 [*cf. R.A.E.*, B **40** 88] and supplies of approved insecticides were distributed free, the results in the Canton of St. Gallen were disappointing, the main reasons being apathy among farmers and faulty application of the materials supplied. A scheme was therefore set on foot in 1947 to commission trained personnel to inspect all cattle in certain areas and apply Antassin [a derris product (*cf. loc. cit.*)] where required. The treatment was repeated 2–4 times during the year as necessary. As a result, the numbers of cattle under treatment and (in brackets) the percentages of animals showing over ten warbles each fell from 1,672 (28·2) in 1947 to 1,421 (21·9) in 1948. Labour costs for the work were low, and it was to be continued.

HAWKES (H. A.). **The Ecology of *Anisopus fenestralis* Scop. (Diptera) in Sewage Bacteria Beds.**—*Ann. appl. Biol.* **39** no. 2 pp. 181–192, 2 graphs, 11 refs. London, 1952.

Anisopus fenestralis (Scop.) is the predominant fly in the sewage bacteria beds at Minworth, near Birmingham [*R.A.E.*, B **40** 29], because trade wastes limit the fauna of scouring organisms and consequently competition between species. Assessment of its populations in the beds by trapping adults at the surface had proved unsatisfactory because of the effect of climatic variation on the numbers caught [*loc. cit.*], and a method was therefore developed of determining the numbers of egg masses, larvae and pupae by sinking, at depths of 1–6, 12–18 and 24–30 inches in the beds, perforated canisters filled with medium from the same level and removing them for examination after 12 weeks or more. The total organic matter in a unit volume of bed was determined by examining samples removed in the same type of canister.

Studies by this method in three of the beds showed that the size of the population of larvae was related to the bed loading as measured by the strength of the sewage and rate of its application. The numbers of larvae and pupae per unit volume decreased with depth, probably because of the greater development of fungal growth nearer the surface. There was no evidence that the larvae migrate upwards before pupation as do those of *Metriocnemus longitarsus* Goetgh. [**24** 91–92]. Their horizontal distribution was found to be affected by the method of distributing the sewage. In the two beds served with fixed spray jets, larvae were more abundant nearer the jets than at some distance away. Although the jets were designed to give even distribution, varying sewage flows and other factors caused areas nearer the jets to receive more sewage and consequently develop a greater accumulation of film. In the bed served with travelling distributors, the larvae were more abundant in the zones below the jets than in the drier intermediate zones, which are moistened only by splashing and condensation. In both types of bed, pupae were relatively more abundant in the drier zones. This indicates a horizontal

migration either of larvae before pupation or of the pupae themselves. Egg masses were found in the zone between the jets, in the bed with travelling distributors.

The incidence of the larvae in all three beds showed recurring peaks throughout 1949, and a more intensive investigation in 1950 in the bed served by travelling distributors showed that this was due to successive generations of the fly. The proximity of the peaks was determined mostly by temperature, and their size by the amount of food available in the bed during larval grazing. Part of the bed was treated with benzene hexachloride as a water-dispersible powder applied at 1·3 lb. γ isomer per acre and another part was untreated. The numbers of larvae present at the time of treatment were greatly reduced in the treated area, but were so large in the untreated one that they depleted the food-supply, and the next and subsequent generations were controlled by intraspecific competition for it. This natural control was retarded by the treatment, the next generation in the treated area being larger than in the untreated one.

Practical recommendations for the control of *A. fenestralis* by limiting food-supply can be based on the results of this investigation. The methods include limitation of the amount of accumulated organic matter in the bed by more efficient removal of the solid matter before the sewage is applied, and restriction of the accumulation of film by re-circulation and double alternate filtration. Since, with the normal single filtration method, any method of distribution that inhibits the luxurious surface growth of fungus will also limit the fly population, distribution by mechanical distributors would appear to be preferable to distribution through spray jets. A further measure could be the removal or neutralisation of toxic components in the sewage to encourage other grazing organisms to compete with the larvae of *A. fenestralis* for the available food. These methods, unlike insecticidal control, do not upset the dynamic balance. The unbalanced state produced by insecticides can be maintained only by continuous and expensive treatment, and the film that accumulates in the absence of the larvae may impair the efficiency of the bed. Under present operating conditions, insecticides must be used, but only when necessary to avert a nuisance. The addition of the insecticide to the sewage to be distributed over the bed seems to be sound practice, as the larvae, which are the most vulnerable stage, are distributed in proportion to the sewage applied.

REID (J. A.). **A preliminary Account of the Forms of *Anopheles leucosphyrus* Dönitz (Diptera : Culicidae).**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 3–4 pp. 42–53, 2 figs., 26 refs. London, 1949.

Anopheles leucosphyrus Dön. appears to consist of several distinct forms [*cf. R.A.E.*, B **24** 223 ; **37** 145], one of which is identified, by examination of a probable cotype in the British Museum, as Dönitz' type form from Sumatra [*cf.* **24** 234]. A tentative key (as well as notes on nomenclature, identification and distribution) is given to the adult females of five forms of *A. leucosphyrus* (vars. *leucosphyrus*, *elegans* (James), *hackeri* Edw., *pujutensis* Colless and *riparis* King & Baisas) and *A. cristatus* King & Baisas, a species that also belongs to the complex and is known only from the Philippines. The material examined included specimens of var. *leucosphyrus* from India, Andamans, Burma, Indo-China, Malaya, Sumatra, Borneo and Philippines, var. *elegans* from India and Ceylon, var. *hackeri* from Malaya and Borneo, var. *pujutensis* from Malaya, Sumatra and Borneo, and var. *riparis* from Malaya. It is thought probable that the sympatric forms will eventually be regarded as distinct species. If so, the form of var. *leucosphyrus* from Luzon [**24** 234]

could be named as a subspecies (geographical race). *A. l. balabacensis* Baisas [**24** 235] is tentatively regarded as the same as var. *leucosphyrus*, which it resembles even more closely than does the Luzon form. Of the two types of Malayan pupae of *A. leucosphyrus* described by Crawford [**27** 234], the one with spine 4 long produces adults of var. *leucosphyrus* and that with spine 4 short produces adults of var. *riparis*.

Specimens of *A. leucosphyrus* sent to the author by McArthur from British North Borneo [**36** 203] were all of var. *leucosphyrus*, and of those taken in a human-bait trap in Malaya, such as were examined by the author were also of this variety, as are specimens from Assam [*cf.* **30** 104] and Burma [*cf.* **38** 201] in the collection of the London School of Hygiene and Tropical Medicine. The exact form of the species seen in Siam in June-July 1943 [**40** 119] could not be determined, but the breeding places were like those usually chosen by var. *leucosphyrus*. All this evidence suggests that var. *leucosphyrus* is a vector of malaria and that it bites man readily ; it has not yet been shown that any of the other forms do so. Very brief notes are given on the breeding places of some of the forms.

VANDERPLANK (F. L.). **The Classification of *Glossina morsitans* Westwood Diptera, Muscidae, including a Description of a new Subspecies, Varieties and Hybrids.**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 3–4 pp. 56–64, 3 pls. (1 col.), 1 map, 5 refs. London, 1949.

It was found in cross-breeding experiments that examples of *Glossina morsitans* Westw. from Kingolwira (Morogoro), Tanganyika, mated more readily with *G. swynnertoni* Aust. from Shinyanga than with their own species and were somewhat reluctant to mate with typical *G. morsitans* from Kondoa Irangi, and it was shown that Kingolwira *morsitans* is genetically about midway between *swynnertoni* and Kondoa *morsitans*. In further experiments, *morsitans* from Ankole, Uganda, mated and bred with Kondoa *morsitans*, showing no signs of preference or sterility, but neither strain bred so readily with *G. m. submorsitans* Newst. from Kaduna, Nigeria, and all male offspring of the latter crosses were sterile. The Kingolwira *morsitans* had abdominal markings and male genitalia similar in many ways to those of *G. m. submorsitans*, and, but for its distribution, might be an intermediate form between the latter and typical Kondoa *morsitans*. *G. m. submorsitans* mated only very reluctantly with *G. swynnertoni*, and none of the females produced full-term offspring. This, together with its geographical distribution, indicates that the Kingolwira *morsitans* is not intermediate between *submorsitans* and Kondoa *morsitans* but is more likely an intermediate between typical *morsitans* and *swynnertoni*. It produced sterile male hybrids when crossed with typical *morsitans*, and its distribution shows that it forms a cline with the latter.

It is here described and is named *G. morsitans orientalis*, subsp. n., though the author states that *G. morsitans* vars. *pallida* Shircore and *paradoxa* Shircore [*R.A.E.*, B **1** 132] appear to be colour varieties of it. He considers that seasonal and environmental changes in colour and size make these unreliable characters on which to base new races or subspecies. The areas of occurrence of *G. m. orientalis*, *G. m. morsitans*, the races of *G. m. submorsitans* described later in the paper, and *G. swynnertoni* are shown on a map. The eastern *morsitans* belt in Tanganyika is bounded on the west by highlands that form an absolute geographical barrier between *orientalis* on the east and typical *morsitans*. The *morsitans* of Portuguese East Africa and Nyasaland also belong to this subspecies. Specimens from parts of Northern Rhodesia appear to be intermediate between typical *morsitans* and *orientalis*. A continuous cline undoubtedly existed between the two subspecies in this area, Northern

Rhodesia and Nyasaland, also through Zambesi Valley in Southern Rhodesia, in comparatively recent times, but from information available it appears that this cline is now severed in several places. *G. swynnertoni* is isolated from *orientalis*, but, as a secondary advancement, its territory now touches that of typical *morsitans*. However, cross-mating with resultant sterility prevents intermingling beyond an overlap of a few miles [*cf.* **37** 4].

On the basis of variations in the male genitalia, *Glossina morsitans submorsitans* is divided into races *submorsitans*, *gambiensis*, n., *ugandensis*, n., and *congolensis*, n. The four races are geographically isolated, and their approximate distributions are given. Five types of hybrid offspring obtained by crossing *G. morsitans orientalis* with *G. swynnertoni* and with *G. m. morsitans*, and *G. m. morsitans* with *G. m. submorsitans* in the laboratory, and two types of second-generation hybrids produced by back-crossing female hybrids with parental males are also described.

VANDERPLANK (F. L.). **Variation in the male Genitalia of the Tsetse Fly *Glossina pallidipes* (Austen) and a Note on *G. austeni* (Newstead).**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 3–4 pp. 65–68, 1 map, 2 refs. London, 1949.

Glossina pallidipes Aust. varies with season and locality in abdominal markings and colour. It is widely distributed in East Africa, and resembles the West African *G. longipalpis* Wied. of which the author thinks it may be a subspecies. Both inhabit thickets in savannah and forest country or bordering on rain forest areas. Although they are very widespread, their distribution is discontinuous, and they occur only as isolated groups. Geological evidence suggests that wet and dry ages have alternated in Africa. It is possible, if this is so, that conditions during the last wet age enabled *G. longipalpis* to spread all over Africa, and that it subsequently became separated into eastern and western groups as a result of changes in the bridges over the natural barrier of mountains and lakes running from north to south in central Africa.

Data are given on cross matings of *G. pallidipes* reared from pupae collected in Shinyanga (Tanganyika), Kisii (Kenya) and Kingolwira (Tanganyika), which are several hundred miles apart. In all, 120 pairings were carried out without any indication of marked genetical changes between the groups being noted. Both sexes of the first-generation offspring were fertile.

The author quotes four characters of the male genitalia given in Newstead's monograph [*R.A.E.*, B **12** 185] for distinguishing *G. longipalpis* and *G. pallidipes*. He accepts one but gives data indicating that the others are not of constant validity. A variation in the genitalia of both *longipalpis* and *pallidipes* that has not been previously noted is a formation of the inner flange-like extension of the superior claspers to form a median lobe-like process. This has been found in one specimen of *longipalpis* from Nigeria and in 1–2 per cent. of *pallidipes* from Uganda and less frequently in *pallidipes* further east. It has not been found in *pallidipes* from the coastal regions of Kenya, Tanganyika or Zululand. The character may be a simple or linked recessive or may be due to hybridisation with *G. morsitans* Westw. It has been found in *G. pallidipes* only in country also inhabited by *G. morsitans*.

The genitalia of numerous individuals of *G. austeni* Newst. from various localities in Kenya, Tanganyika, Portuguese East Africa and Zululand have been examined, and little variation has been noted except that the size of the inner flange or median lobes varies in a cline from north to south. It is small in the north and large in the south. There are slight variations in the relative sizes of the superior claspers, but none sufficient to suggest that any races of *austeni* exist.

VANDERPLANK (F. L.). **The Classification of *Glossina palpalis*, including the Descriptions of new Subspecies and Hybrids.**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 3–4 pp. 69–77, 2 pls., 1 fig., 1 map, 5 refs. London, 1949.

The literature on the nomenclature of variants of *Glossina palpalis* (R.-D.) is briefly reviewed, and the results are given of the examination of the genitalia of batches of males of this species from several different localities, each batch usually consisting of 20–50 specimens. Material in the British Museum was also examined, and preparations of other parts of the flies were made and studied. Cross-breeding experiments [*cf. R.A.E.*, B **39** 131] had shown that *G. palpalis palpalis* from Nigeria, *G. p. fuscipes* Newst. from Uganda and *G. p. martinii* Zumpt from Lake Tanganyika could be regarded as distinct subspecies but not as species. *G. palpalis* in the north-western extremity of its range could be distinguished in many ways from these three subspecies and is named *G. p. gambiensis*, subsp. n. This form occurs in Gambia and Senegal. Again, *G. palpalis* from Angola, the south-western extremity of its range, had distinctive coloration and male genitalia. Austen had already named this colour variety as *G. p. wellmani*, but as the name *wellmani* has been applied to colour varieties from other parts, and both Austen and Newstead failed to recognise any distinctive features in the genitalia of the original *wellmani*, the author names the Angola form *G. palpalis angolensis*, subsp. n. It is distributed along rivers in the west of Angola. There is, or was until comparatively recently, a cline between all subspecies, and a natural graduation from one subspecies to another. Coloration and size are variable, but some generalisations are nevertheless given. The superior claspers show a graduation in size and shape with subspecies, but measurements would have to be relative to be of value. The only reliable characters are those of the inferior claspers, and these are given for the five subspecies, for *G. tachinoides* Westw., *G. pallicera* Big. and *G. caliginea* Aust. and for four hybrids of subspecies. Methods of examining the inferior claspers are discussed. The approximate distribution of the subspecies is given and shown on a map. The shape of the inferior claspers of *G. p. fuscipes* varies in a cline from north to south, but the variation is not so pronounced as the differences between the subspecies. Six first-generation types of hybrids between various subspecies of *G. palpalis* have been produced and two second-generation types and also several backcrosses.

SQUIRE (F. A.). **On the Sex Ratio in *Glossina*.**—*Bull. ent. Res.* **43** pt. 2 pp. 231–235, 7 refs. London, 1952.

Catches of *Glossina* commonly include a preponderance of males, and the reason for this has been the subject of much speculation. Attention is here drawn to the connection between the sex ratio and the age of the flies caught. It is shown from data on catches [of *G. palpalis* (R.-D.)] at Njala, Sierra Leone, that the percentage of females is higher in the first age-group (with smoky wings) than in the second (tawny-winged) or third (frayed), the male/female ratios being 2·6, 6·4 and 3·3. Subdivision of the flies of the first age-group into those that are teneral (having a soft yielding thorax when held securely between thumb and finger) and those that are not shows that the higher proportion of females is entirely due to the teneral class, which show the true natural ratio of unity. Non-teneral females in the first age group are as scarce as females in the second and more so than those in the third. Females thus become fugitive at the end of the teneral period, about seven days after emergence and about two days before the first egg passes into the uterus. During the teneral period, mating is prolonged, vigorous and frequent, and mating scars [*R.A.E.*, B **40** 41] appear early. As the uterus lies under and between the mating cushions, it would be unsafe for females with eggs or young larvae

in the uterus to mate. There is less danger to third-instar larvae, as the highly chitinised polypneustic lobes give protection from the male claspers. Mating can also occur safely during the intervals of 2–3 days between larviposition and the descent of the next egg to the uterus. This is calculated to give a total of at least 4–6 days available for safe mating in the non-teneral part of the first period, 10–15 in the second and 4–6 in the third, assuming uninterrupted fecundity. This is probably an underestimate, particularly in the third age group, when reproductive capacity is likely to be declining. There appears therefore to be some relationship between the sex ratio in catches and the reproductive capacity in the different age groups. Though age is thought to be the chief factor influencing sex ratios in catches, it is not the only one.

HOCKING (B.) & RICHARDS (W. R.). **Biology and Control of Labrador Black Flies (Diptera : Simuliidae).**—*Bull. ent. Res.* **43** pt. 2 pp. 237–257, 2 pls., 4 figs., 25 refs. London, 1952.

In spite of the very low density of the human population and of other mammals and birds in Labrador, Simuliids are extremely abundant. The conditions near Goose Bay, where the establishment of an air base has made control desirable, are briefly described, and a list is given of 19 species found there in 1949 and 1950, with indications of their relative abundance, importance as pests of man, seasonal incidence, temperature requirements and larval habitats. In addition to these, six undescribed species were recorded. The most important pest species were *Simulium venustum* Say and *Prosimulium hirtipes* (Fries). *S. venustum*, by far the most numerous and troublesome, was the only important species for which there was evidence of more than one generation a year at Goose Bay. It reached its peak of abundance in mid-August and continued active well into September.

A circular area with an eight-mile radius round the airport was surveyed in May and June 1950 for important breeding sites, and 77 of the 163 streams and rivers investigated were found to provide suitable conditions. Larvae were practically eliminated from them in June by DDT solution, usually at 10 per cent. in fuel oil and an auxiliary solvent, applied at a rate of 1·5 p.p.m.-minutes from a helicopter, conventional aircraft or boats or by hand application from the ground. The desired dosage was 1 part DDT in 10 million parts water for 15 minutes, but the time had often to be reduced and the concentration correspondingly increased when application was from the air. The repopulation of the area by the Simuliids was studied. It appeared that even under the most favourable conditions, with a large population moving into a suitable and unpopulated area, it is unusual for *P. hirtipes* to lay its eggs as far as two miles from the site of emergence, whereas *S. venustum* may clearly extend its range by at least two miles during the season and probably during one generation. Seasonal averages showed a great reduction in numbers of Simuliids at the centre of the treated area and a worth-while reduction 2–4 miles from the circumference. Even near the centre, however, Simuliids were sometimes troublesome late in the season. It is suggested that, where *P. hirtipes* is the important species, relief for at least one season could be secured by eliminating larvae within a radius of two miles. For *S. venustum*, a six-mile radius is suggested. No adverse effects on fish or other useful fauna were recorded.

HADAWAY (A. B.) & BARLOW (F.). **Studies on aqueous Suspensions of Insecticides. Part III. Factors affecting the Persistence of some synthetic Insecticides.**—*Bull. ent. Res.* **43** pt. 2 pp. 281–311, 3 pls., 20 refs. London, 1952.

In continuation of studies on the influence of particle size on the effectiveness of insecticides in aqueous suspension [*R.A.E.*, B **39** 51 ; **40** 80], which

decreases as the intrinsic toxicity of the insecticide increases, persistence of deposits of four insecticides, and particularly the effect of initial particle size, was studied on different surfaces. There is an inverse relationship between particle size and initial contact toxicity and also between particle size and fumigant effect, the latter because of the increase in surface area that accompanies decrease in size. The tests were made on females of *Aëdes aegypti* (L), and the compounds tested, in order of decreasing immediate contact toxicity to them, were dieldrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene), γ BHC (benzene hexachloride), aldrin (1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendo - methanonaphthalene) and DDT. Fumigant effect, estimated from mortality of mosquitos held $\frac{1}{4}$ inch away from the deposit by gauze, was greatest in γ BHC, considerable in aldrin, comparatively slight in dieldrin and negligible in DDT. The compounds were not repellent to the mosquitos when direct contact was prevented.

For any given particle size, the order of persistence was DDT, dieldrin, γ BHC and aldrin. The larger the particle the longer the duration of effectiveness. Persistence was influenced considerably by the type of material to which the insecticides were applied. The most striking results were obtained on mud blocks made from red earths or lateritic soils used in the construction of walls of houses in the tropics. Particles of all four insecticides applied at 25 mg. per square ft. rapidly disappeared from the surface. When the surface deposits were no longer visible, the toxicity of DDT or dieldrin was completely lost, but that of γ BHC or aldrin persisted at a reduced level for many weeks. Almost the whole of the dosage of crystals measuring 10–20μ of DDT and γ BHC could be recovered from inside the blocks. There is ample evidence to show that the lasting toxicity of blocks treated with γ BHC or aldrin is due to fumigant effect from the material inside the blocks. The rate of disappearance of particles from the surface of mud blocks decreased as the relative humidity of the atmosphere increased. Particles of all the insecticides persisted much longer on plaster blocks and wallboard than on mud blocks. Plaster blocks and wallboard also retained some toxicity to mosquitos after the crystals of aldrin and γ BHC had disappeared from the surface, but not for so long as mud blocks. Particles of these two insecticides persisted longer on glass plates than on mud blocks, but toxicity was lost completely as soon as they disappeared from the surface. BHC was more effective than aldrin against mosquitos and persisted longer on both mud and plaster. Commercial formulations behaved on the different materials in the same way as the pure crystals.

The practical importance of the results is discussed. The chief finding from the point of view of the control of Anophelines by spraying the internal surfaces of houses is the rapid disappearance of surface deposits from mud. The persistence of an insecticide can be increased by increasing the particle size but this means a loss in effectiveness against mosquitos. DDT particles larger than 40μ are not very effective, and no advantage is to be gained by spraying mud with particles larger than this. On the other hand, when using BHC or aldrin, which have fumigant action after the disappearance of surface deposits on mud, it is desirable to apply small particles to obtain the maximum initial and ultimate lasting effect. The relative effectiveness of crystals of BHC or aldrin of different particle size ranges changes with time. At first the smaller sizes have a more efficient contact action than the larger, but they disappear rapidly. The blocks retain a fumigant action but this is less effective than contact with the larger particles, which still remain on the surface. Ultimately the large particles also disappear and the blocks sprayed with the smaller crystals regain their superiority because of their more pronounced fumigant action. The authors conclude that it does not seem possible to deduce more

than this from the experiments described. The difference in effectiveness of DDT and BHC wettable powders against *Anopheles gambiae* Giles in houses with mud walls in Africa [**39** 187] may be accounted for partly by the ineffectiveness of the large DDT particles used in some wettable powders and partly by the rapid entry of both insecticides into the wall, resulting in the case of DDT in complete loss of toxicity and in that of BHC in a persistent fumigant effect.

POTTS (W. H.) & JACKSON (C. H. N.). **The Shinyanga Game Destruction Experiment.**—*Bull. ent. Res.* **43** pt. 2 pp. 365–374, 1 map, 6 refs. London, 1952.

An experiment made at Shinyanga in 1945–50 was designed to determine whether the common savannah species of tsetse, *Glossina morsitans* Westw., *G. swynnertoni* Aust. and *G. pallidipes* Aust., could be eradicated by the destruction of the hoofed game animals under conditions prevailing in Tanganyika and if so over what period and at what cost. The area chosen was bush country some 600 square miles in extent and was isolated from invading flies on all sides by wide stretches of treeless country and nearly isolated from invading game animals on the east, south and west by settlements. On the north, shooting did not effectively prevent animals from entering from the grassy plain, and a game fence 50 miles long was erected in 1948. More than 8,500 game animals were shot in the area over the five years. There were originally some ten animals per square mile. The Tanganyika bushland is understocked with game, and where areas are needed for human use, game could be absorbed by remaining areas.

As a result of the shooting, *G. morsitans* and *G. swynnertoni* were exterminated and *G. pallidipes* was either exterminated or very considerably reduced; experimental cattle remained healthy in the area for 11 months from November 1950 until October 1951, after which they were removed. This result was achieved in spite of considerable invasion of the area by cattle, particularly late in the campaign when the alternative source of food might have been expected to be particularly valuable to the fly. There was evidence that the fat content, non-fatty dry weight and size of the flies decreased during the experiment, but there was no evident effect on mean age or the proportion of females in the catches, nor apparently did the flies turn to avian blood [*cf. R.A.E.*, B **15** 35–36].

The cost of the work was £50 per square mile, but it would be very much higher than this in areas not naturally isolated from the rest of the fly belt. Under these conditions, shooting would have to continue indefinitely or a fence would have to be erected and maintained. Game destruction is not recommended except in isolated areas of manageable size. Elsewhere, discriminative clearing of the habitats of the fly, even though initially much more costly, is preferable because the effect is more lasting.

MORRIS (K. R. S.). **The Ecology of epidemic Sleeping Sickness. II. The Effects of an Epidemic.**—*Bull. ent. Res.* **43** pt. 2 pp. 375–396, 1 pl., 3 graphs, 4 maps, 13 refs. London, 1952.

The following is based on the author's summary. The most obvious effect of the sleeping sickness caused by *Trypanosoma gambiense* [*cf. R.A.E.*, B **40** 5] is depopulation owing to direct mortality and to induced sterility and increased infant mortality. The problem was studied in the north of the Gold Coast and the neighbouring French Upper Volta Territory, where severe epidemics have occurred in localised form since at least the middle of the 19th century and in widespread form during the past 30 years [**40** 6, 102]. The vectors have been the two riverine species, *Glossina palpalis* (R.-D.) and *G. tachinoides* Westw. A close correlation was found between the incidence of

sleeping sickness and the population trend, with a marked depopulating effect at infection rates above 3 per cent. The rates of infection and depopulation both showed closely similar relationships to the proximity of the nearest fly-belt. These studies led to the conclusion that sleeping sickness had been directly responsible for the depopulation of large tracts of country along the Black Volta and its major tributaries. A situation within one mile of the fly-belt endangers the chances of survival of a village, and danger of infection ceases only at a distance of 3–4 miles.

Data obtained from French sources concerning severe losses from sleeping sickness, ranging from those occurring in individual towns and villages along the Black Volta at the beginning of the century to the widespread depopulation of whole districts by 1940, are discussed. In an advanced stage of the epidemic, a characteristic pattern of population displacement appeared, with the main rivers completely or partly depopulated and population concentrating near headwaters and on watersheds. This displacement was giving rise to ecological changes, which brought an increasing pressure of adverse factors on the people. The desertion of the river valleys was followed by the rapid regeneration of bush and invasion by wild life, especially the larger game animals, and later by the appearance of *G. morsitans* Westw. [*cf.* **34** 19]. At this stage, which had been reached in much of the territory of the epidemic, the loss of the river valleys for agriculture and grazing was complete, and increasing numbers of game and *G. morsitans* were threatening the prosperity of adjacent agricultural communities. Depopulation from any cause is liable to be followed by the entry of *G. morsitans*, which may then become a dangerous factor in the process.

It is possible to differentiate between *Glossina* as a primary cause of depopulation, when it has initiated the process, and as a secondary factor, when it has entered at some later stage. The distinction has an important bearing on control. The most stable and generally satisfactory method of controlling *G. morsitans* appears to be the establishment of a settled population of sufficient density and size. This measure can eradicate the fly so long as it is a secondary factor in depopulation. Direct measures against *Glossina* are thought necessary when it is a primary factor. Thus, the situation in the north-west of the Gold Coast has been met by eradication of the riverine *G. palpalis* and *G. tachinoides* and resettlement of the depopulated parts of the river valley. The intrusion of *G. morsitans* ceased as soon as settlement to sufficient density was achieved.

VAN TIEL (N.). **Improvement of the residual Toxicity of DDT Solutions by the Addition of Coumarone Resin.**—*Bull. ent. Res.* **43** pt. 2 pp. 413–419, 5 graphs, 10 refs. London, 1952.

An investigation was made to find means of increasing the effectiveness of deposits of DDT from kerosene solutions by producing smaller crystals, and to ascertain whether the higher toxicity thus obtained would allow the DDT content of the solution to be reduced without loss of effectiveness. Reduction of the DDT content would remove the risk of crystallisation during storage at low temperatures and the need for auxiliary solvents. Tests were made on *Musca domestica* L. by a technique that is briefly described. A distinct relationship between crystal size and the toxicity of a deposit was observed. Deposits of fine crystals (about 100μ long) from solutions in xylene were very much more toxic than deposits of coarse crystals (about 2,000μ long) from solutions in kerosene.

The addition of small quantities of coumarone resin to a kerosene solution of DDT reduced the size of the DDT crystals and considerably increased toxicity. The increase in toxicity was greatest when the ratio of resin to DDT was about

1 : 10. When the proportion of resin was increased above this, the effect decreased, owing to masking of the DDT crystals. With a resin-DDT ratio of 1 : 2, the resin made the deposits less toxic than the deposit from the corresponding DDT solution without resin. Deposits on various substances, including glass, from a solution of 3 per cent. DDT and 0·3 per cent. resin in kerosene, were permanently more toxic than those from an equal quantity of a 5 per cent. DDT solution without resin. Deposits on glass from a solution of 1 per cent. DDT and 0·1 per cent. resin in kerosene were more effective than those from a 5 per cent. DDT solution without resin for 69 days, but after this the position was reversed. Check experiments with *Aëdes aegypti* (L.) showed that a very considerable increase in toxicity resulted from the addition of resin to DDT solution.

HARRISON (R. A.). **Further Studies on DDT-resistant Houseflies in New Zealand.**—*N.Z. J. Sci. Tech.* **33** (B) no. 2 pp. 92–95, 7 refs. Wellington, N.Z., 1951.

The DDT-resistant line G of *Musca domestica* L. [*R.A.E.*, B **40** 92] bred in the laboratory without further exposure to DDT was still resistant in the 19th generation. In one of two series of tests in which females were exposed for five minutes, deposits of 100–3,200 mg. per sq. ft. killed 3 per cent. or less ; in the other, deposits of 25, 50 and 100 mg. all gave 4 per cent. kill. To obtain kills of these flies similar to those of a non-resistant line with deposits of 6·25-100 mg., exposure had to be 18 times as long. Three exposures of the same individuals at 24-hour intervals had a cumulative effect and produced mortalities similar to those likely to have been obtained if the three exposures had been continuous. A line of flies was bred from line G through 17 generations by exposing flies of each generation to DDT deposits and rearing the succeeding generation from the survivors. Exposure to DDT did not impair the egg-laying capacity of the females and there was no indication of delayed lethal effects.

HARRISON (R. A.). **A Note on the Toxicity to Houseflies of DDT Residues.**—*N. Z. J. Sci. Tech.* **33** (B) no. 2 pp. 96–98, 3 refs. Wellington, N.Z., 1951.

The results are given of an investigation on the duration of effectiveness against *Musca domestica* L. of DDT films on plain plywood or plywood treated five or 113 days before with oil paint or 81–82 days before with water paint, oil-bound water paint, or synthetic enamel. The films were formed by spraying panels with 5 per cent. solutions of pure p,p'DDT in kerosene to leave deposits of 800 mg. per sq. ft. on unpainted wood and 200 mg. per sq. ft. on painted surfaces, and the panels were joined to form cages in which the flies were confined for an hour. Knockdown was recorded at the end of exposure and mortality 24 hours later. Deposits on the fresh oil paint were not toxic at any time. The rates of mortality were 100 and over 80 per cent. on enamel after 324 and 1,353 days, oil-bound water paint after 324 and 1,316 days, water paint after 387 and 909 days and the old oil paint after 261 and 324 days, and they were 100 and 97·7 per cent. on untreated wood after 198 and 1,399 days. All deposits were only slightly toxic to flies of a DDT-resistant strain.

GORDON (R. M.), KERSHAW (W. E.), CREWE (W.) & OLDROYD (H.). **The Problem of Loiasis in West Africa with special Reference to recent Investigations at Kumba in the British Cameroons and at Sapele in Southern Nigeria.**—*Trans. R. Soc. trop. Med. Hyg.* **44** no. 1 pp. 11–41, 4 pls., 2 maps, 74 refs. London, 1950.

The following is almost entirely based on the authors' summary. The problem of human infection with *Filaria* (*Loa*) *loa* in British West Africa is

discussed with special reference to investigations carried out by members of the Loiasis Research Scheme, at Kumba in the British Cameroon [*R.A.E.*, B **40** 10] and at Sapele in Southern Nigeria. The distribution of loiasis in West Africa is shown to correspond closely with the distribution of *Chrysops silacea* Aust. and *C. dimidiata* Wulp, but these Tabanids are practically confined to the equatorial rain forest, and workers in the south-western province of the Sudan, which touches the edge of this area. have shown that *C. distinctipennis* Aust. is the main vector there and *C. longicornis* Macq. a possible one [*cf.* **39** 176]. These four species belong to the subgenus *Kleineana*, but the evidence against *C. longicornis* is considered doubtful on the grounds that it also occurs outside the area of loiasis and that *F. loa* has not been found in it in nature and has shown partial but not complete development in it in the few feeding experiments recorded.

Although adults of only *C. silacea* and *C. dimidiata* were taken at Kumba, five species of *Chrysops* (*C. silacea, C. dimidiata, C. longicornis, C. langi* Beq. and *C. griseicollis* Beq.) were bred from larvae collected there. As the three additional species were not found biting man, it is suggested that they feed on other hosts, probably monkeys. Although both sexes of *Chrysops* were bred in normal proportions from pupae, not a single male was noted amongst more than 2,000 adults of *C. silacea* and *C. dimidiata* taken at Kumba and at Sapele. It is pointed out that the site at which the males occur is a point of more than academic interest, since it probably determines the route taken by the recently emerged females and this, in its turn, may have a bearing on possible methods of control.

It has been shown that *C. silacea* and *C. dimidiata* occur in large numbers in the high canopy of the forest surrounding habitations at Kumba, and that they descend to bite man at ground level only when clearings have been made in the forest. It is suggested that at Kumba, the forest canopy is their normal habitat and that when man is not available, monkeys are their chief source of blood. On the rubber estates at Sapele, where the tree canopy is low and the undergrowth is not so dense as at Kumba, *C. silacea* and *C. dimidiata* can easily perceive man at ground level and readily descend from the canopy to feed on him. Monkeys appear to be rare on the rubber estates at Sapele, but they are very numerous at Kumba, and the canopy-dwelling species there harboured filariae closely resembling *F. loa*.

It has been shown that *Chrysops* is a "pool feeder" [*cf.* **40** 9] and that having lacerated the tissues it takes up not less than 10–20 cu.mm. blood when feeding to repletion. The bearing of these observations on the proportion of flies found infected in nature is discussed. Evidence is produced suggesting that the infective larvae of *F. loa* when deposited by the feeding fly may not be able to penetrate unbroken skin.

The life-cycle of *F. loa* in the vertebrate and in the invertebrate host is discussed. Some of the results of loiasis surveys carried out on the human population at Kumba are recorded. It is shown, by repeated examinations of relatively large quantities of blood (50 cu.mm.), that in some people the microfilariae may be found constantly present in large numbers whilst in others the number found is small and their appearance is intermittent. Although it would appear that the proportion of cases without microfilariae in the peripheral blood can be greatly reduced by increasing the intensity of the examination, yet there remains a residuum of cases amongst those living in a hyperendemic area in which prolonged examinations fail to reveal microfilariae. Various possible explanations of these phenomena are put forward. The reactions of the human host to the presence of the larval and adult stages of *F. loa* are discussed, with special reference to the occurrence of "Calabar swellings." It is concluded that the seriousness of loiasis is usually underestimated. Various possible methods of controlling it are discussed, and it is emphasised that the

knowledge available concerning the parasite and its vector is insufficient to warrant the recommendation of any particular method of control on a large scale.

RAY (H. N.). **Hereditary Transmission of *Theileria annulata* Infection in the Tick, *Hyalomma aegyptium* Neum.**—*Trans. R. Soc. trop. Med. Hyg.* **44** no. 1 pp. 93–104, 11 figs., 24 refs. London, 1950. *Hyalomma aegyptium*.—*T.c.* no. 2 p. 236.

Detailed evidence is produced in the main paper that infection with *Theileria annulata* is transmitted to calves by the adult progeny, but not by the larval or nymphal progeny, of infected ticks of a species of *Hyalomma* [*R.A.E.*, B **38** 13–14]. Progeny of adults collected in June 1940 from a farm in the West Punjab where the disease was prevalent among calves were reared through six generations on calves at the Veterinary Research Institute, Mukteswar, and the infection was transmitted by adults of the first and third generations. The progeny of others collected in September 1945 on the same farm transmitted it as adults at Mukteswar up to the fourth generation (1948). The salivary glands of a few adults of the fifth and sixth generations revealed the presence of theileria parasites in their acini, but the number of infected acini was not so high as in the fourth-generation adults. The larvae and nymphs failed to transmit the disease to calves. *T. annulata* is not known to occur in calves born at the Institute, the tick has not been recorded from the locality, and all experimental animals were examined before being exposed to it.

In the supplementary note, the author concludes that the tick in question, which he had referred to as *H. aegyptium* Neum., was *H. savignyi* (Gerv.). He agrees with the view that the true *H. aegyptium* [L.] is normally a parasite of reptiles and, though it has been recorded on hedgehogs [**39** 201], does not occur on domestic animals [*cf.* also **24** 196].

BOHART (G. E.) & GRESSITT (J. L.). **Filth-inhabiting Flies of Guam.**—*Bull. Bishop Mus.* no. 204, vii+152 pp. 17 pls., 14 figs., 133 refs. Honolulu, 1951.

The greater part of this work consists of a systematic survey of the flies associated with filth (excrement, decaying flesh and certain decaying plant materials) in Guam, with notes on morphology, distribution and habits. Much of the information is based on specimens and data accumulated by the authors and other members of a United States Naval Medical Research Unit. Most of the species are recorded from Guam for the first time. Keys are given to the adults of about 100 species and to the eggs, larvae and pupae of many of them. Introductory sections include very brief notes on the methods by which flies were collected and studied and the probable relation of flies in Guam to disease, particularly intestinal infections [*cf.* *R.A.E.*, B **38** 73], and details of the various common substances that attract flies in Guam for breeding or other purposes and the species associated with each. The food-habits of the larvae and adults of the common filth-inhabiting flies are tabulated. Brief notes are given on the natural enemies that hold down fly populations in Guam, and possible methods of controlling flies there and on other Pacific Islands are discussed.

It is concluded that *Chrysomyia megacephala* (F.) and *Musca sorbens* Wied. are medically the most important filth flies in Guam [*cf.* **39** 39] and probably on other Pacific islands [*cf.* **39** 69]. It seemed probable that many species usually considered innocuous spread disease on Guam to some extent. These include *Atherigona excisa* (Thoms.) (*orientalis* Schiner), which was the commonest fly and fed on or bred in almost every kind of decaying matter, though the bulk of its breeding seemed to be in rotting fruits and vegetables, and *Megaselia*

scalaris (Lw.), of which the larvae developed rapidly in moist putrid substances, and the adults were abundant indoors and able to reach excrement and human food where larger flies were excluded.

GALLIARD (H.) & BOUTET (R.). **Effets de la chimiothérapie de l'infection à *Trypanosoma cruzi* Chagas chez les Réduvidés hématophages.**—*C. R. Soc. Biol.* **145** no. 3–4 pp. 304–307, 1 ref. Paris, 1951.

The experiments described were made to ascertain the effect on *Trypanosoma cruzi* in Triatomine bugs of drugs that affect it in the blood. The drugs used were lomidine or pentamidine [diamidinodiphenoxypentane] and Bayer 7602 [diallylmalondi(4-amino-2-methyl-quinolyl-6-amide], both of which act against the trypanosome, and nivaquine [sontochin], which the authors had previously found to prolong and intensify infection in mice. In a first series, infected individuals of *Rhodnius prolixus* Stål emitting metacyclic forms in their faeces were allowed to engorge on mice that had received five injections of 0·3 mg. lomidine at intervals of two days, or one of 2 mg. or four of 0·8 mg. Bayer 7602. There was a temporary reduction in the number of trypanosomes in the faeces, but this subsequently returned to normal. Moreover, many of the bugs died. In a second series of experiments, uninfected individuals of *Triatoma infestans* (Klug) and *Rhodnius* were allowed to engorge partly on uninfected mice that had received 2 mg. Bayer 7602 or 1 mg. nivaquine, respectively, and then to complete the meal on an infected mouse. The concentration of trypanosomes in the faeces of the bugs was temporarily increased as compared with controls, but later returned to normal, and infection persisted indefinitely. All the bugs survived. In a similar experiment with 1 mg. lomidine and *T. infestans*, the number of metacyclic forms in the faeces did not rise, but all the bugs died.

When the faeces of the bugs in the first series were used to infect mice by cutaneous scarification, it was found that none of the chemicals had modified the virulence of the infection during contact in the gut. In similar tests with faeces of the bugs used in the second experiment when infection was at its height, virulence was immensely enhanced by Bayer 7602 and nivaquine, but the increased virulence was lost on passage. Inoculation with faeces when they again contained only the usual number of trypanosomes produced only a normal infection. With lomidine, no increase of virulence was apparent even at the height of infection, but there was oscillation of the infection curve and prolongation of infection on passage. The hypervirulent infection caused in mice by Bayer 7602 was arrested by treatment with the same drug, whereas nivaquine enhanced it still further.

PAPERS NOTICED BY TITLE ONLY.

LEESON (H. S.). **The recorded Distribution of *Ornithodoros moubata* (Murray) (Acarina).**—*Bull. ent. Res.* **43** pt. 2 pp. 407–411, 1 map, 34 refs. London, 1952.

WOMERSLEY (H.). **The Scrub-typhus and Scrub-itch Mites (Trombiculidae, Acarina) of the Asiatic-Pacific Region.**—*Rec. S. Aust. Mus.* **10** pts. 1–2 pp. 1–673, 118 pls., 3 figs., 2 graphs, 196 refs. Adelaide, 1952. Price £A3 3*s*.

HOPKINS (G. H. E.) & CLAY (T.). **A Check List of the Genera and Species of Mallophaga.**—$8\frac{3}{4} \times 5\frac{3}{4}$ ins., [5+] 362 pp. London, Brit. Mus. (Nat. Hist.), 1952. Price £2.

MATTINGLY (P. F.). **The Sub-genus *Stegomyia* (Diptera, Culicidae) in the Ethiopian Region. I. A preliminary Study of the Distribution of Species occurring in the West African Sub-region with Notes on Taxonomy and Bionomics.**—*Bull. Brit. Mus.* (*nat. Hist.*) Ent. **2** no. 5 pp. 235–304, 16 figs., 8 pp. refs. London, 1952.

The following is virtually the author's synopsis. This paper deals with the distribution of the species of the subgenus *Stegomyia* of *Aëdes* occurring in the West African sub-region. All the species of wide distribution in the Ethiopian Region are, however, included and the topographical data therefore cover most of the region. *Aëdes aegypti* (L.) is treated very briefly since it is regarded as a special case meriting a separate paper. Zoogeography is discussed mainly in relation to rainfall and altitude. Temperature and vegetational relationships will be discussed in later papers. Such notes on taxonomy and bionomics are included as appear to be necessary for an understanding of distribution. These also will be discussed at greater length in later papers in the series.

WHITEHEAD (F. E.). **Rice Field Mosquito Control by Pellet-borne Insecticides.** —*Bull. Ark. agric. Exp. Sta.* no. 511, 30 pp., 7 refs. Fayetteville, Ark., 1951.

The results are given of tests of larvicides for the control of *Psorophora confinnis* (Lynch Arrib.) and *P. discolor* (Coq.), in rice-fields in Arkansas ; DDT was used in 1948, DDT, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], chlordan, parathion and toxaphene in 1949, and dieldrin and DDT in 1950. Applications were made from an aeroplane in field tests and by methods designed to simulate aeroplane application in plot tests. The results obtained in 1948 and 1949 indicated that penetration of the heavy vegetative cover was necessary for reliable control and was not obtained with a fine dust or spray, that applications made after larvae are present are more effective than those made before the eggs hatch, and that larvicides exposed to weathering in the field before flooding lose effectiveness. Parathion, aldrin and dieldrin were effective at lower rates of application than the other larvicides, and dieldrin was the most effective because it retained its toxicity better when exposed to weathering than aldrin or parathion. Mixing toxicants with fertiliser in such a way that separation did not occur (introducing them in solution) showed much promise as an inexpensive control measure where it is practicable.

In 1950, effective penetration of the vegetation was readily obtained by using pellets incorporating 5 per cent. insecticide. Promising pellets were prepared by rubbing a stiff paste of equal parts of finely ground rice husks and powdered bentonite through a 16-mesh screen and scraping it off when dry, but a proprietary pelletised bentonite (20–40 mesh), and ammonium sulphate were also used. A solution of the insecticide in xylene was mixed with the pellets or with the ingredients of the mixture, and the solvent was evaporated by an electric fan during the process. The sulphate pellets release the insecticide because they are soluble in water, and the bentonite pellets do so because they disintegrate as the bentonite absorbs water. When the pellets prepared from the mixture were dropped into water, some of them sank almost immediately, leaving a trail of finely divided particles. Others floated for some time, and small particles flaked off, until the whole pellet sank, again leaving a trail of suspended particles. As the bentonite in the pellets on the bottom absorbed more water, small particles of rice hulls returned to the surface. These pellets gave better results than those of ammonium sulphate but were not so effective

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as the pelletised bentonite, which absorbs enormous quantities of water and so breaks up very readily.

In plot tests, dieldrin in each of the three kinds of pellets at 0·1, 0·05 and 0·02 lb. per acre gave practically complete control. It lost its effectiveness in four days of exposure on dry soil before flooding when applied at 0·01 lb. per acre in each type of carrier, but was still quite effective at 0·02 lb. per acre in the pelletised bentonite. It was fairly effective in the rice-husk and bentonite pellets but ineffective in ammonium sulphate. When the pellets were exposed for two days on wet soil before flooding, they were generally less effective than when they were put on dry ground and flooded immediately, but dieldrin at 0·05 lb. per acre in pelletised bentonite still gave complete control. As it is not desirable to be dependent on one insecticide, DDT was also tested in pelletised bentonite. Excellent results (about 99 per cent. control) were obtained in each of 12 plots treated with pellets two days after flooding at rates to give 0·1 or 0·05 lb. DDT per acre. In those treated with the same amounts immediately or one week before flooding or four days after flooding, control ranged down to 60 per cent. In a further plot test, 0·025 lb. DDT per acre applied two days after flooding gave better results than 0·05 or 0·1 lb. immediately before flooding.

Out of 15 field tests made in 1950 with dieldrin and DDT, more than 99 per cent. control of larvae was obtained in seven fields and excellent control in two others. In two of the remaining fields, there was evidence of poor coverage at the time of application, in two others 0·1 lb. DDT was applied to dry soil and results resembled those obtained in plot tests under similar conditions, in one there was evidence of movement of toxicant with water current, and in the remaining field, unevenness of the floor resulted in uneven drying, with late oviposition in some places and correspondingly late hatching. Apparently by the time these larvae hatched in the upper part of the field, much DDT had been carried away and insufficient was left there to be effective. In addition to giving good penetration, the bentonite pellets were inexpensive and easy to prepare and handle, and kept well in store. Because they were comparatively heavy and did not drift, they could be applied from greater heights and under conditions of greater air movement than dusts or sprays, and these qualities, together with the small dosage needed, made practicable the use of smaller, cheaper aeroplanes flying for more hours of the day.

Insecticides highly toxic to man are less dangerous in pellets than as dusts or sprays. Aquatic Coleoptera were about as susceptible as mosquito larvae to dieldrin. Aquatic Hemiptera were less so. Results of observations on *Gambusia affinis* were erratic, but at least under some conditions, the fish could survive for a week in water treated with dieldrin at 0·1 lb. per acre. Observations indicated that water from treated fields would afford little hazard to game fish in the area, though all possible precautions should be taken. There was strong evidence that the treatments were not injurious to rice.

Typhus Fever in California 1916–1948, inclusive.—99 pp., 6 figs., 7 graphs, 10 maps (1 fldg.), 1 fldg. table, 105 refs. San Francisco, Calif., Dep. publ. Hlth Calif., 1950.

This work consists of four papers, followed by a bibliography and a tabulated summary of the 506 cases of typhus fever that had been reported in California up to the end of 1948. The papers are **An epidemiologic and Field Laboratory Study, 1916–1948, inclusive** by M. D. Beck & A. Van Allen (pp. 5–30), **Clinical Description and Findings in 100 Cases** by Beck (pp. 31–37), **Laboratory Aids in the Diagnosis of Typhus Fever** by H. L. Bodily, L. E. French & Van Allen (pp. 38–42) and **Control Operations** by A. H. Dahl (pp. 43–53).

In the first paper, the history of typhus fever in man in California is reviewed, and epidemiological studies made at a field laboratory from 1943 until the end of 1948 are summarised. The cases are studied in two groups. The first, comprising one doubtful case reported in 1909 and 32 occurring in 1916 and 1917, when the disease is believed to have been carried by lice [*Pediculus humanus humanus* L.] [*cf. R.A.E.*, B **5** 91, 170], is dealt with very briefly. The second, comprising all the others, of which the first occurred in 1919, is treated at greater length. It consisted of 473 reported flea-borne cases from five southern counties. The number was greatest in 1945 and 1946 (62 in each year) and fell to 15 in 1948. Geographical, seasonal, age, sex, racial and occupational distribution and multiple infections in families and households are discussed.

The field studies, begun in February 1943, showed for the first time in California the presence of typhus-fever rickettsiae in the brain of a rat (*Rattus rattus alexandrinus*) associated with the work place of a patient. The organisation of surveys is described, and the results are given. Surveys were made in 16 counties, and 1,718 rodents, 12 cats and one owl and 157 ectoparasite pools were tested by laboratory methods. *R. norvegicus*, *R. rattus*, *R. r. alexandrinus*, mice (*Mus musculus*) and five pools of fleas were found naturally infected. Positive animals were found in the five counties reporting human cases, and one rat in a control county was found positive by complement fixation test. Experimental work showed that *Citellus beecheyi* can be infected with a murine strain of typhus fever and so may act as a reservoir of infection. The results of a serological survey are also given.

In the last paper, it is stated that typhus control consists mainly of the control of domestic rodents and their parasites, of which only *Xenopsylla cheopis* (Roths.) is thought to be important. In California, it largely amounts to modifying procedure that has been in use for many years against plague. Flea control with 5 per cent. DDT dust, environmental sanitation, rat proofing and rat eradication are discussed.

PARKER (R. R.), PICKENS (E. G.), LACKMAN (D. B.), BELL (E. J.) & THRAIKILL (F. B.). **Isolation and Characterization of Rocky Mountain Spotted Fever Rickettsiae from the Rabbit Tick** *Haemaphysalis leporis-palustris* **Packard.**—*Publ. Hlth Rep.* **66** no. 15 pp. 455–463, 7 refs. Washington, D. C., 1951.

The isolation is recorded of seven strains of rickettsiae of Rocky Mountain spotted fever from *Haemaphysalis leporis-palustris* (Pack.) found in nature in 1948 and 1949 on rabbits (*Sylvilagus*) in the Bitter Root Valley of western Montana. Although these strains appeared to be serologically and immunologically identical with a laboratory strain of Rocky Mountain spotted fever and infection of guineapigs with living rickettsiae protected against challenge with a virulent strain of spotted-fever rickettsiae, they were of low virulence for guineapigs [*cf. R.A.E.*, B **17** 126 ; **21** 238]. One of the rabbits on which the ticks were found had specific complement-fixing antibodies for spotted fever. Sera from eight of ten hares (*Lepus americanus*) taken during the same period as the rabbits were positive for spotted fever by complement fixation, and examples of *H. leporis-palustris* from three of the positive hares contained spotted-fever rickettsiae, while those from the other five did not. Out of 286 mammals, including 61 rabbits (*S. nuttallii*), from the same general area, examined in 1946 and 1947, six rabbits gave a positive reaction by complement fixation for spotted fever [*cf.* **35** 34]. Strains of spotted-fever rickettsiae of low and high virulence to guineapigs have been isolated from *Dermacentor andersoni* Stiles, and it is possible that this tick acquired the strains of low virulence by feeding on rabbits that had been infected by *H. leporis-palustris*.

Woke (P. A.). **A Rabbit-ear Cage for bloodsucking Arthropods.**—*Publ. Hlth Rep.* **66** no. 15 pp. 464–471, 2 figs., 4 refs. Washington, D. C., 1951.

Details are given of the construction and attachment of a light-weight cage of transparent celluloid, metal-wire cloth and bolting silk designed to enclose the ears of a rabbit for the purpose of feeding blood-sucking Arthropods. It allows of easy manipulation and affords a good view of the interior, and appears to cause little discomfort to the rabbit. No serious injury to the rabbit was observed when one cage was used to permit engorgement of 2,700 larvae, 250 nymphs or 25 adults of ticks, to rear 4,000 body lice [*Pediculus humanus humanus* L.], in a period of six weeks, or to maintain 1,000 fleas (*Ctenocephalides canis* (Curt.)) for six days. Atmospheric conditions within the cage may be closely controlled when necessary.

Downs (W. G.) & Bordas (E.). **A Malaria Survey of the Southern Territory of Lower California.**—*Amer. J. trop. Med.* **29** no. 5 pp. 695–699, 4 refs. Baltimore, Md., 1949.

The Southern Territory of Lower California comprises the part of the peninsula south of 28°N. lat. It has a hot dry climate and most of it is desert or semi-desert ; the towns are situated where natural springs occur or where water is near the surface, and are actually small oases. Rain falls on only a few days in the year and most of it comes in September in heavy downpours of short duration. A survey in 1948 of the four towns reported to be malarious showed that malaria caused by *Plasmodium vivax* was endemic in them. The spleen and parasite rates in 805 children, 5–15 years old, were 19·3 and 7·8 per cent. *Anopheles pseudopunctipennis* Theo., the only Anopheline recorded from the Territory, was the only species seen. Adults and eggs examined were all of the typical form. In all the localities visited, breeding in general depended on springs, which provide the only surface water. It was always heaviest in the presence of algal mats. Breeding conditions in the four towns are discussed. Densities of 5–10 Anophelines per house were found near the breeding areas in two towns and of over 100 in a third. As there are few natural resting places for mosquitos, it is probable that they rest chiefly in houses and man-made shelters. Spraying of dwellings with DDT to leave a toxic deposit was recommended and carried out in September and November 1948. Eradication of Anophelines from the area visited is thought to be practicable, as each breeding focus is separated from the next by 30–150 miles and could be dealt with as a unit.

de Rodaniche (E. C.). **Experimental Transmission of Q Fever by** *Amblyomma cajennense*.—*Amer. J. trop. Med.* **29** no. 5 pp. 711–714. 8 refs. Baltimore, Md., 1949.

An account is given of the laboratory experiments in Panama in which *Amblyomma cayennense* (F.) was shown to be able to transmit *Rickettsia burneti*, the causal organism of Q fever [*R.A.E.*, B **40** 69]. Ticks that had acquired the infection by feeding as larvae on an infected guineapig transmitted it to fresh guineapigs by feeding as nymphs and adults. Only one infected female laid eggs. The few larvae reared from them failed to transmit infection to guineapigs on which they fed or to yield evidence of infection when injected intraperitoneally as a suspension in salt solution. *A. cayennense* is abundant in Panama and has a wide host range.

SCHLOSSER (R. J.). **Photomicrographs of the developing Larvae of *Wuchereria bancrofti* in a Mosquito Host of the South Pacific Area.**—*Amer. J. trop. Med.* **29** no. 5 pp. 739–745, 20 figs., 1 ref. Baltimore, Md., 1949.

During investigations on filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* in the Solomon Islands [*cf. R.A.E.*, B **37** 10] in which mosquitos of the fifth and sixth laboratory generations were used, the worms did not survive for more than four days in *Anopheles punctulatus* Dön., and though larvae developed normally for seven days in *A. farauti* Lav., none of the mosquitos survived longer than this. As it was thought that this might have been due to weakening of the strain by laboratory rearing, blood-fed females from native villages in Guadalcanal, where cases of filariasis existed, were collected for subsequent work. Out of 195 females of *A. farauti* and 200 of *A. punctulatus* dissected, 47 and 30, respectively, contained larvae of *F. bancrofti*, some of which had reached the infective stage. Fully developed larvae assumed to be *F.* (*D*[*irofilaria*]) *immitis* were also seen in the abdomens of some females of *A. farauti*.

About 1,000 first-generation offspring of the adults of *A. farauti* caught in the villages were used for observations on the larvae of *F. bancrofti*, and photomicrographs are given showing their day-to-day development in females of this species, infected by feeding on natives of San Cristobal. Mortality among the mosquitos was low. All dissections showed that in less than 24 hours most of the microfilariae picked up by the mosquitos had migrated to the thorax and were ex-sheathed. Several worms found in the stomachs after 24 hours were still very active, and later dissections indicated that some of these eventually reach the thorax and develop. The photographic technique is discussed.

PERRY (W. J.). **The Mosquitoes and Mosquito-borne Diseases of the Treasury Islands (British Solomon Islands).**—*Amer. J. trop. Med.* **29** no. 5 pp. 747–758, 7 figs., 19 refs. Baltimore, Md., 1949.

The Treasury group of islands was one of the advance bases from which operations were carried out against the Japanese in 1943. Little was known of their mosquito fauna or mosquito-borne diseases on them when they were first occupied. Parasitological surveys showed malaria to be of primary importance on Stirling and Mono, the two main islands of the group. Dengue has not been reported from the Islands, and there were no outbreaks in the military forces during the occupation. The occurrence of dengue in the Solomon Islands appears to depend on the existence of conditions favourable to *Aëdes aegypti* (L.) [*cf. R.A.E.*, B **39** 174], and although there were numerous opportunities for this mosquito to develop on the Treasury Islands, it had not been introduced up to 1945. Blood-smear studies on the inhabitants of a village on the south coast of Mono Island revealed a 0·7 per cent. infectivity rate for *Filaria* (*Wuchereria*) *bancrofti*. No intermediate hosts were found with infective-stage larvae, but *Anopheles farauti* Lav. was suspected of being the chief vector on the basis of epidemiology and the evidence of the literature [*cf.* **39** 69, etc.], and because it showed the highest incidence of developing larvae in the thoraces of the mosquitos dissected.

The development of mosquitos in the Treasury Islands is affected by several important topographical features, including the densely wooded and shaded character of Mono and Stirling, the flushing of the many streams on Mono Island by frequent and heavy rain, the rarity of flooding of coastal beaches and of blocking of river and stream outlets by tidal action, the excellent drainage afforded by the thin layer of soil and humus covering a porous coral floor, and the scarcity of commercial coconut plantations. A key is given to the

fourth-instar larvae of the ten species of mosquitos (*A. farauti* and nine species of four other genera) found in a six months' survey of Mono and Stirling Islands. On Mono Island, collections were made only on the southern coast at altitudes below 500 ft. Notes are also given on the breeding places in which each species was found. The Anopheline larvae were examined by L. E. Rozeboom, who concluded that although they showed constant morphological characters different from those reported for the species from the New Hebrides and Solomon Islands [**35** 161, 172], they were definitely *A. farauti*.

SKALIY (P.) & HAYES jr. (W. J.). **The Biology of** *Liponyssus bacoti* (**Hirst, 1913**) (**Acarina, Liponyssidae**).—*Amer. J. trop. Med.* **29** no. 5 pp. 759–772, 30 refs. Baltimore, Md., 1949.

A method is described of rearing *Liponyssus bacoti* (Hirst) through its whole life-cycle in a tube (13×100 mm.) where it is constantly available for observation. The tube was stoppered with black non-absorbent cotton covered with black nylon netting, and was fitted with a strip of roughened black filter paper. For feeding, the prepared tail of a rat was introduced into the tube. The rat was held in a metal tube with a grating at one end and a lid at the other with a hole through which the tail was passed. The tail was washed and shaved, and a strip on the dorsum then had to be scraped with a razor blade so as to leave a membrane that did not bleed but was delicate enough to enable the protonymphs to feed. The tail was fastened into the tube containing the mites with plasticine, and left there for one hour daily when mites were numerous, or until all were seen to have fed, and every three days when there were only a few. Moisture that sometimes condensed inside the tube during feeding was dried with a gentle stream of dry air that entered the tube through one hole of a two-holed rubber stopper and passed out through the second hole. Attempts to find artificial methods of feeding the mites failed. Eggs were laid on the filter paper, which was transferred to a fresh tube. A pre-heated ring encircling the tube was used to drive mites slowly from one tube to another, and electrically heated rings to prevent the escape of mites from tubes that had to be left open for some time.

Completion of the life-cycle requires two complete blood engorgements, one by the protonymph [*cf. R.A.E.*, B **37** 140] and one by the adult. Protonymphs usually needed two or more feedings for engorgement, but most adults engorged during the first feeding. The shortest egg-to-egg cycle observed was 13 days, as compared with 10–12 days in the experiments with mites that had free access to a rat [*loc. cit.*]. The success with which mites were reared, the duration of the egg stage and the percentage of mites reaching the adult stage after different numbers of days under various conditions of temperature and humidity are shown in tables. Mortality during the whole process of development was lowest (37·5 per cent.) under conditions in the open laboratory where the average temperature was 25°C. [77°F.] and the relative humidity 47 per cent., but there were indications that a higher relative humidity favoured the survival of the eggs. Mortality was greatest in the protonymph stage. The average life of the adult female in the open laboratory was 61·9 days and the average number of eggs laid per female was 98·8. There was no significant difference in total egg production and length of adult life of fertilised and unfertilised females. Unfertilised eggs developed into males [*cf. loc. cit.*]. Eggs were laid and protonymphs developed at 12–14°C. [53·6–57·2°F.], probably the lowest temperature at which the mite can reproduce, but the life-cycle was greatly lengthened and mortality higher than normal. At low and intermediate temperatures, the mites withstood a wide range of relative humidity (18–20 per cent. at 24–26°C. [about 77°F.] but higher humidity is needed at high temperatures (over 60 per cent. at 34–36°C. [about 95°F.]).

The mites used in this work belonged to a strain originally collected on *Rattus norvegicus* in Savannah, Georgia. Observations there in January and February 1948 showed the lowest temperature of the accessible parts of burrows of this rat to be 7·2°C. [44·96°F.] and the relative humidity usually over 90 per cent. but never 100 per cent. Apparently, even in the coldest months in the Savannah area, many days occur when some reproduction of *L. bacoti* would be possible.

HERTIG (M.). *Phlebotomus* **and residual DDT in Greece and Italy.**—*Amer. J. trop. Med.* **29** no. 5 pp. 773–809, 8 figs., 29 refs. Baltimore, Md., 1949.

It has been apparent for some time that the spraying of houses with DDT for the control of Anophelines as an anti-malaria measure also automatically controls sandflies (*Phlebotomus*), but only incidental attention has been paid to this. In Greece, an extensive anti-Anopheline campaign was carried out during 1945–48 [*R.A.E.*, B **37** 11–12; **39** 109, 132], and its effect on sandflies was studied from 6th June to 24th October 1948. A list is given of the 11 species of *Phlebotomus* (including *Sergentomyia*) previously recorded from the Greek mainland and from Crete. The application of DDT deposits was begun in 1945 and continued on a large scale in 1946, when 700,000 houses and outbuildings, mostly in villages, were sprayed. It was estimated that 80 per cent. of the population in malarious areas throughout continental Greece and the islands had been protected, a proportion that was later increased. The solutions used at first were largely replaced in 1947 and 1948 by emulsified solutions. The only anti-larval measure was the spraying of some swampy areas from aircraft. Sandflies are normally abundant throughout most of Greece and Crete. They were scarce in 1948, and their abundance in contrast in certain villages near Athens and one of its suburbs where DDT had not been used indicated that the campaign was responsible. Details are given of observations in several areas. People volunteered the information that annoyance from *Phlebotomus* had ceased with the first application of DDT. No sandflies were found in sprayed buildings, and night observations out-of-doors showed them to be scarce in sprayed areas. A considerable reduction in Athens, although the whole city had not been sprayed, is attributed in part to the effect on their surroundings of the many treated buildings scattered through the urban areas and in part to the use of household sprays. Brief notes are given on materials and methods.

The status of leishmaniasis in Canea, Crete, in 1948 is compared with that of previous years [**26** 256]. A marked decline in human visceral leishmaniasis had occurred before DDT was used. It was associated with the destruction of infected dogs and a general reduction of the dog population, which was apparently approaching normal again in 1948. Populations of *Phlebotomus* (predominantly *P. papatasi* (Scop.)) in Canea as well as other parts of Crete were found to be low in 1948, even though, as at Athens, the town had not been included in the campaign. It was difficult to assess the effect of this on visceral leishmaniasis because of lack of information about reservoirs other than dogs and man, normal long-term cycles of the disease or other factors. A sharp drop in the incidence of cutaneous leishmaniasis coincided with the introduction of DDT treatment in 1946, and was maintained.

A large-scale experiment in the control of cutaneous leishmaniasis in the Province of Teramo in the Abruzzi, Italy, was begun in 1948, when an examination of 28,000 people showed that nearly 3 per cent. had active lesions and about 21 per cent. had scars. The inside walls and ceilings of practically every building over an area of some 80 sq. miles were sprayed with 2 gm. DDT per sq. metre in June-August 1948. Three sides of the experimental area adjoin equally

heavily infected territory. It was visited in the third week of August when observations were made on *P. perfiliewi* Parrot, the dominant sandfly and supposed vector, in treated and untreated districts. The sandflies were taken in considerable numbers in the latter. In a treated building, the destruction of great numbers after contact with DDT deposits was watched. The control effected was apparently causing a progressive reduction of the local sandfly population. Sandflies are stated to have ceased to be a problem in the Pontine Marshes since an anti-Anopheline campaign with DDT was carried out in 1944–45.

In Sardinia, where *P. papatasi* had been plentiful, every man-made structure was sprayed with DDT during the winter of 1947–48 [*cf.* **38** 215, etc.]. No sandflies were found in houses 8–9 months later, and they were very scarce elsewhere.

On the basis of the present and previously published work, it is concluded that treatment of interiors with DDT deposits gives immediate and virtually complete protection from *Phlebotomus* indoors, and that house spraying alone, in compact communities, with one treatment a year, preferably before the season begins, eventually reduces the *Phlebotomus* population within the sprayed areas to near vanishing point.

KAHN (M. C.) & OFFENHAUSER jr. (W.). **The first Field Tests of recorded Mosquito Sounds used for Mosquito Destruction.**—*Amer. J. trop. Med.* **29** no. 5 pp. 811–825, 6 figs., 1 ref. Baltimore, Md., 1949.

Early literature on the influence of sound in attracting mosquitos is briefly reviewed, and an account is given of a field experiment carried out during the summer of 1948 in Cuba in which the sounds made by single females of *Anopheles albimanus* Wied. were recorded and reproduced through a loudspeaker enclosed within an electrically-charged screen in the swamp from which the females had come. Males of *A. albimanus* were attracted towards the loudspeaker in quite large numbers (several hundred on some evenings) and were electrocuted by the screen. The sounds made by the females of *A. albimanus* were significantly different from those made by all other mosquitos previously recorded by the authors [*R.A.E.*, B **38** 8]. To kill the males in a way that would not prevent accurate determination of species and sex, a trap that would be lethal to man had to be used, but for practical control it should be possible to design a means of killing the mosquitos that would not harm people or farm animals. The electrical discharges showed that activity was considerable for an hour before nightfall and 40 minutes after it, with the peak about 15 minutes before it became quite dark. The number of mosquitos killed during a peak period of ten minutes by the sound trap exceeded the number of females of *A. albimanus* taken in a cattle-baited trap in a week or more. The ratios of males of *A. albimanus* to all other mosquitos killed by the sound trap and to all *A. albimanus* of both sexes averaged 68·5 and 91 per cent., respectively, and showed little variation. When the trap was operated without sound as a control less than half as many mosquitos were taken and the corresponding percentages of males of *A. albimanus* were only 14 and 31.

The following are among the conclusions drawn from the experiment. The calls that seem of lowest pitch to the human ear seem most effective for calling males. The playing of the records seemingly will not induce flight activity in males at times when they are not normally active but will alter their course during periods of normal activity. The reproduced sounds may be louder than those normally made by the mosquito in nature, but should not be excessively loud as there appears to be an upper threshold beyond which the sounds may be repellent. This threshold is reached when the sound can be heard by an unaided human ear some quarter of a mile away under very quiet conditions.

Kahn (M. C.) & Offenhauser jr. (W.). **The Identification of certain West African Mosquitoes by Sound.**—*Amer. J. trop. Med.* **29** no. 5 pp. 827–836, 3 figs., refs. Baltimore, Md., 1949.

Details are given of the apparatus and methods used to record the sounds made by certain mosquitos in Nigeria for purposes of identification by species and sex, together with a list of the records made and an analysis of some of the sounds. When played back, all the sounds recorded proved distinctive.

Gillett (J. D.). **Further Notes on the Ethiopian Species of *Taeniorhynchus* Arribalzaga (Diptera, Culicidae).**—*Proc. R. ent. Soc. Lond.* (B) **18** pt. 5–6 pp. 97–102, 8 refs. London, 1949.

Examination of the types of *Mansonia* (*Taeniorhynchus*) *fraseri* (Theo.), which, on the authority of Edwards, has long been considered a synonym of *M.* (*T.*) *aurites* (Theo.), showed that it was a distinct species and that *M.* (*T.*) *atroapicalis* Gillett [*R.A.E.*, B **34** 92] is a synonym of it. Redescriptions of the adults of both species are given, as well as brief notes on their distribution and their larvae and pupae, and an amended key to the adults of the species of *Mansonia* (*Taeniorhynchus*) of the Ethiopian Region.

Backhouse (T. C.) & Heydon (G. A. M.). **Filariasis in Melanesia : Observations at Rabaul relating to Incidence and Vectors.**—*Trans. R. Soc. trop. Med. Hyg.* **44** no. 3 pp. 291–306, 2 figs., 21 refs. London, 1950.

Data obtained in 1930, 1933 and 1935 are given on the prevalence of filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* in natives of New Guinea and adjacent islands, the periodicity of the microfilariae in this area, and the vectors of the infection in the neighbourhood of Rabaul (New Britain). Microfilariae were found in 19·4 per cent. of 427 adult males from various districts examined at Rabaul, and in 35·1 and 32·9 per cent. of 131 and 188 adults of both sexes on two widely separated small islands, Makada (20 miles north of Rabaul) and Matty (about 200 miles west of Manus), respectively. There was very little elephantiasis. Rates tended to be higher in men from the New Guinea mainland than in natives of New Britain.

The early literature on periodicity of the microfilariae in the area is reviewed, and the suggestion that a non-periodic form exists in New Guinea [*R.A.E.*, B **3** 24] is shown to rest on a misinterpretation of a statement made by F. Fülleborn in 1911. The results of night and day counts at Rabaul, Makada and Matty are tabulated. There were generally large numbers of microfilariae in the night blood and often a few in the day blood. When there are large numbers at night, some are usually seen by day also if enough blood is examined, and the findings support the accepted view that *F. bancrofti* in this region is nocturnal [**19** 28]. In one of two experiments made by A. C. Ewing in 1935 on Matty Island over a period of five days on the reversal of periodicity by reversing the hours of sleep, the microfilaria peak had been delayed about 4 hours by the fifth day. In the other, where there were only moderate numbers of microfilariae, the peak appeared to have been changed by a full 12 hours.

Possible mosquito vectors are reviewed. Experiments in Rabaul with the local *Culex pipiens* var. *fatigans* Wied. showed that it would not be an efficient vector of the Melanesian *F. bancrofti*. No developing or mature larvae were found in 50 females of *Aëdes scutellaris* (Wlk.) from Makada, and none developed in 26 females of the same species fed on the infective blood of a native of New Britain. Similar results were obtained with the local *A. aegypti* (L.), and only retarded larvae were found in *Armigeres* sp. Mature larvae were found in several females of *Aëdes kochi* (Dön.) after experimental infection and healthy

immature larvae in nearly all the others dissected. However, although this night-biting species, which is fairly common about Rabaul, evidently has considerable potentialities as a host, it is probably not of widespread importance because it breeds only in water in leaf axils. Five females of *Anopheles punctulatus* Dön. and 47 of *A. farauti* Lav. that had been collected in villages on Makada were examined at Rabaul. The five *punctulatus* females were negative, but 12 of the 32 *farauti* females dissected in detail showed filarial larvae in various stages of development, and some of the larvae had reached the infective stage in five. The other 15 were examined hastily for advanced larvae only and yielded none. Most positive results were obtained in the first mosquitos dissected. It is suggested that larvae may be able to escape from females kept for some time, during acts other than blood-sucking, possibly during the sucking of fruit juices. In further dissections of a few laboratory-reared females fed on an infective person, one out of five of *A. farauti* and one out of three of *A. punctulatus* became fully infective. When females of *A. annulipes* Wlk. reared from locally collected larvae and pupae were allowed to feed on the blood of a white man between 9 and 10 p.m. when it showed 33 and 36 microfilariae per 20 cu.mm., five dissected 12–22 days later showed 53, 29, 16, 17 and 0 mature larvae, as well as many living immature larvae and no chitinised microfilariae. Many of the infective larvae were in the head and proboscis. These results indicate that *A. annulatus*, the commonest Anopheline of the southern States of Australia, is rather well suited to be an intermediate host of *F. bancrofti*. Although *A. farauti* was not shown to be an outstandingly favourable host for the Melanesian *F. bancrofti* in this work, the findings of others [*cf.* **34** 123 ; **39** 69] and its prevalence in coastal areas and constant presence in regions of high endemicity indicate that it is the chief vector.

Burns (K. F.) & Matumoto (M.). **Japanese Equine Encephalomyelitis 1947 Epizootic. I. Epizootiology.**—*J. Amer. vet. med. Ass.* **115** no. 870 pp. 167–170, 1 map, 5 refs. Chicago, Ill., 1949.

Burns (K. F.), Tigertt (W. D.) & Matumoto (M.). **II. Serological and etiological Studies.**—*Amer. J. Hyg.* **50** no. 1 pp. 27–45, 2 figs., 9 refs. Lancaster, Pa., 1949.

In the first of these papers, data are given on a widespread epizootic of encephalomyelitis that occurred among horses in Japan in the summer and autumn of 1947 ; it comprised 1,209 reported cases with a fatality rate of 50·5 per cent. The studies described in the second paper indicated that the virus concerned was probably identical with that of Japanese B encephalitis, though there was no corresponding outbreak in man or fowls [*cf. R.A.E.*, B **38** 194]. It seems probable that the disease is mosquito-borne, and if so, its occurrence in horses and not to any extent in man or birds may be correlated with the feeding habits of the vector.

Hammon (W. McD.), Rees (D. M.), Casals (J.) & Meiklejohn (G.). **Experimental Transmission of Japanese B Encephalitis Virus by** *Culex tritaeniorhynchus* **and** *Culex pipiens* **var.** *pallens*, **suspected natural Vectors.**—*Amer. J. Hyg.* **50** no. 1 pp. 46–50, 14 refs. Lancaster, Pa., 1949.

Hammon (W. McD.), Tigertt (W. D.), Sather (G.) & Schenker (H.). **Isolations of Japanese B Encephalitis Virus from naturally infected** *Culex tritaeniorhynchus* **collected in Japan.**—*T.c.* pp. 51–56, 8 refs.

It is shown by a review of the literature in the first paper that the virus of Japanese B (epidemic) encephalitis has been transmitted by experimentally infected mosquitos of many species, including *Culex pipiens* var. *pallens* Coq.,

C. tritaeniorhynchus Giles, *Aëdes japonicus* (Theo.), *A. albopictus* (Skuse), *A. togoi* (Theo.), *Armigeres obturbans* (Wlk.) and *Anopheles hyrcanus sinensis* Wied. in Japan, *C. sitiens* Wied. (*jepsoni* Theo.), *C. pipiens* var. *fatigans* Wied. (*quinquefasciatus*, auct.) and *Aëdes vexans* (Mg.) in Guam, *C. annulirostris* Skuse and *C. pipiens* var. *fatigans* in Ponape (eastern Caroline Islands), and *C. pipiens* vars. *molestus* Forsk., *pipiens* L. and *fatigans*, *C. tarsalis* Coq., *A. dorsalis* (Mg.), *A. nigromaculis* (Ludl.), *Culiseta inornata* (Will.) and *C. incidens* (Thoms.) in the United States.

An account is given of further experiments, carried out in 1947, in which females of *Culex tritaeniorhynchus* and *C. pipiens pallens* (reared from larvae collected in the Tokyo area) acquired the virus by feeding on high-titred suspensions and transmitted it to immature mice by biting, beginning to do so eight days after the infective meal. Both are numerous in the endemic areas of Japan, and *C. tritaeniorhynchus* is the mosquito of which the seasonal incidence most closely corresponds with the epidemic period.

The literature on the isolation and attempted isolation of the virus from naturally infected mosquitos is reviewed in the second paper. Its isolation from *C. pipiens* and *C. tritaeniorhynchus* in the Maritime Province of the Soviet Far East [*R.A.E.*, B **31** 72 ; *cf.* also **37** 146] and from *C. tritaeniorhynchus* and *C. p. pallens* in Japan [**31** 3] has been recorded, and M. Kitaoka has informed the authors that he and his fellow-workers isolated it from a pool of *C. tritaeniorhynchus*, a pool of mixed *Culex* spp. and a pool of *Anopheles hyrcanus sinensis* Wied. taken in the Tokyo area in 1948. Its further isolation by the authors from *C. tritaeniorhynchus* collected just before the onset of an outbreak of the disease near Okayama in 1948 is recorded. Results with *C. pipiens* and *A. hyrcanus sinensis* collected in the same area at the same time were negative.

DARROW (E. M.). **Factors in the Elimination of the immature Stages of** *Anopheles quadrimaculatus* **Say in a Water Level Fluctuation Cycle.**—*Amer. J. Hyg.* **50** no. 2 pp. 207–235, 7 figs., 22 refs. Lancaster, Pa., 1949.

The following is almost entirely based on the author's summary. The object of this study was to determine the mechanisms by which control of *Anopheles quadrimaculatus* Say in impounded water is effected by the last two phases of water-level management, cyclical fluctuation and seasonal recession [*cf. R.A.E.*, B **33** 123]. It is thought that larvae that leave the shelter of the marginal vegetation as the water level falls do not survive, because they suffer from lack of food and are exposed to fish and other predators in the open water, but that stranded larvae may sometimes survive on mud for the duration of a fluctuation cycle. In an experimental pool at a drawdown rate somewhat faster than is usual in the main reservoir system of the Tennessee Valley Authority, 75–100 per cent. of the larvae migrated with the receding waters. The numbers stranded appeared to be inversely proportional to the rate of water-level recession and directly proportional to the intersection values [**33** 122, etc.] in the de-watered area. All instars were equally susceptible to stranding.

Observations indicated that predators, which included three species of Dolichopodids, a Saldid bug and possibly a Carabid beetle, were responsible for about 21 and 38 per cent. mortality of stranded larvae and pupae during a period of eight hours in the middle of the day, but were not active at night.

The climatic effects on stranded fourth-instar larvae and pupae were mainly a function of water loss. During the night, when the relative humidity remained at about 100 per cent., mortality of larvae amounted to about 11 per cent. and there was no mortality among pupae. In the daytime, the mortality rate of stranded larvae and pupae protected from predators was correlated most closely with the evaporation rate. Observed mortalities in percentages were plotted on arithmetic probability paper against evaporation as measured by a Livingston

atmometer so that an estimate of the evaporation necessary for effective kill of the larvae and pupae could be derived. On the assumption that 90 per cent. mortality is effective kill, this proved to be 28·5 ml. for larvae and 33·4 ml. for pupae. Differences in soil moisture had no demonstrable effect on the mortality of larvae when evaporation was similar, but trampled soil of a soupy consistency enabled larvae to survive more evaporation than did firm soil.

The combined effects of exposure to predators and climate for periods of eight hours on clear summer days caused the death of about 92 per cent. of larvae and 75 per cent. of pupae. Under the most favourable conditions observed for survival, apart from rainy weather, all of the fourth-instar larvae were dead at the end of 48 hours' exposure.

In controlled laboratory studies, first- and fourth-instar larvae and pupae were exposed on soil to saturated air. Because of the negligible evaporation in the exposure chamber, significant differences in mortalities could be attributed to differences in the moisture content of the soil. Exposure at 25°C. [77°F.] on loam soil with moisture contents of 24·7 and 22·2 per cent. caused 50 per cent. mortality among fourth-instar larvae in 37·2 and 27·8 hours, respectively. The actual effect of soil in prolonging the life of larvae depends on the availability of the moisture present. This varies with the type of soil as well as with its moisture content. Thus the periods required for 50 per cent. mortality of fourth-instar larvae were 39·6 hours on sandy loam with a moisture content of only 15 per cent. and 37·2 hours on loam with a moisture content averaging 24·7 per cent. Saturated air was more lethal at 31°C. [87·8°F.] than at 25°C., presumably because the higher temperature increased diffusion of the water vapour and resulted in an increase in evaporation.

First-instar larvae were more susceptible to desiccation than were fourth-instar larvae, and all were dead after exposure on loam for a day and a half at 25°C. in a saturated atmosphere. Fourth-instar larvae exposed under comparable conditions survived 2–3 days, according to soil moisture. Pupae exposed on soil to saturated air in the laboratory survived up to the time for eclosion about as well as controls kept in water. However, the proportion able to transform successfully into adults was only 55–72 per cent. of that in the controls. The length of the exposure time beyond 12 hours did not have a demonstrable effect on this proportion. Pupae that were forced to transform on the mud were, on the average, only 80 per cent. as successful as those exposed for the same length of time on mud and then transferred to water. The moisture content of the soil on which they were exposed was not observed to make a difference in the proportion able to transform successfully.

Eggs had to be kept moist for 0·2–0·3 of their total development period to acquire a degree of resistance to desiccation. Eggs incubated for this period survived up to 54 hours at 25°C. and 65 per cent. relative humidity. When the eggs were desiccated under these conditions for shorter times, it was found that they had ceased development for the length of time they were out of water. When the relative humidity was 100 per cent., eggs continued to develop although out of water and on a dry substratum.

QUARTERMAN (K. D.), BAKER (W. C.) & JENSEN (J. A.). **The Importance of Sanitation in Municipal Fly Control.**—*Amer. J. trop. Med.* **29** no. 6 pp. 973–982, 2 figs., 11 refs. Baltimore, Md., 1949.

The following is substantially the authors' summary. Surveys were made to determine the sources of flies (mainly *Musca domestica* L. and blowflies) in the city of Savannah, Georgia, which has a population of about 130,000. Fly dispersal tests were made using laboratory-reared flies of a yellow-eyed mutant strain of the common blowfly, *Callitroga macellaria* (F.). They indicated that this

species would move readily from the city dump into the city proper. Tests carried out under weather conditions that were rather unfavourable to fly activity showed that it would travel in all directions from the point of release in the city and for distances of up to 1·5 miles.

Results of the tests and surveys of breeding places indicated that the city garbage dump, which was about three miles from the heart of the business district, was the main source of flies in the city. Garbage bins and dog faeces were the only important sources in residential areas. Fly breeding in the "' garbage sludge " that accumulated in the bottom of containers or in the soil under those that were inadequate or unserviceable was found to occur in about 60 per cent. of all containers examined. The percentages of containers involved in active fly production in the various typical urban areas were 69 in the best residential area, 62 in the middle-class section, 56 in the tenement district and 61 in the business district. The percentages of premises found positive for fly breeding in dog faeces were 41 in the best residential area, 20 in the middle-class section, and 7 in the tenement district. All privies in the city probably produce flies, but the number of privies is small. Abattoirs, poultry houses and stables have a high rate of fly production but are not numerous. No significant breeding was found in fertiliser plants, grocery stores, creameries, feed stores or fowl yards.

The relative importance of the various sources of flies in cities varies with local conditions, and each city should be surveyed thoroughly by competent observers before municipal control is attempted. No sources of breeding were found in Savannah that could not be eliminated or greatly reduced by improved sanitary practice. In view of the added benefits of partial control of rats, cockroaches and other pests that would accompany fly control by improved sanitation and also the appearance in various parts of the world of strains of flies resistant to insecticides, it is thought appropriate to re-emphasise the importance of sanitation as an effective and economical method of municipal fly control.

Holway (R. T.), Mitchell (W. A.) & Abdel Aziz Salah. **Studies on the seasonal Prevalence and Dispersal of the Egyptian Housefly. I. The Adult Flies.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 381–398, 8 figs., 5 refs. Columbus, Ohio, 1951.

Changes in populations of adults of *Musca domestica vicina* Macq. in various situations in four typical Egyptian villages in Giza Province were estimated by the grill count method [*R.A.E.*, B **38** 158] in order to study the seasonal prevalence and movements of the flies. The following is based on the authors' summary of the findings. The flies showed a marked tendency to concentrate at the more attractive foci. They were consistently most numerous in zones of greatest concentration, particularly inside buildings, and this made it possible to obtain a relative index of changes in abundance by making counts at only a few selected situations.

Counts became progressively higher during the day as temperatures rose to about 30°C. [86°F.], but tended to decrease if they rose much above this [*cf.* **37** 57]. There was usually a late afternoon drop in the fly index regardless of temperatures. This was probably associated with the approach of sunset and choice of night resting places. Relative humidity did not appear to be a factor in dispersal to the inside of buildings. It is concluded that the flies tend to disperse between inside and outside resting places according to temperature, consistently choosing the situation with the higher temperature below 20°C. [68°F.] and with the lower temperature above 30°C. It is probable that temperatures exert the greater influence on dispersal below 25°C. [77°F.]

and attractions between 25° and 30°C. This dispersal of flies according to differences of temperature may be useful for determining the best time to apply space sprays, whether out of doors or indoors.

Seasonal trends were consistent at all the villages. The flies were least plentiful during late December, January and February, when mean temperatures were below 15°C. [59°F.], and increased rapidly in numbers from March to June, when an extremely high peak of indoor abundance was reached. The rate of increase was greatest when mean temperatures were between 20° and 25°C. During July and August, while they were above 25°C., abundance fell rapidly, but it rose again in September as temperatures fell below 25°C. Densities increased throughout the autumn, but never as much as in May and June. As temperatures became lower from September to December, the flies tended to spend more of the day outside houses. There was a drop in outside counts in May, several weeks before the numbers inside began to fall, and the counts remained low during July and August but increased in the autumn.

Although the grill index method of comparing fly densities does not provide a true estimate of population, it is sensitive enough to give useful information, when due regard is paid to dispersal, on the progress and effectiveness of control campaigns, especially where control work continues over a period of several weeks or months.

Fairchild (G. B.) & Hertig (M.). **Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). VII. The Subgenus *Shannonomyina* Pratt.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 399–421, 52 figs., 14 refs. Columbus, Ohio, 1951. **VIII. Two new Species of *Warileya*.**—*T.c.* pp. 422–429, 24 figs., 7 refs.

In the first paper, the characters of the subgenus *Shannonomyina* [*R.A.E.*, B **37** 186] of *Phlebotomus* (in which the authors include *Psychodopygus*) are given, with an extended discussion of the spermathecae, which are of particular importance in this group. There is a check list of the species of the subgenus, most of which are known only from one sex, and keys to the adults of both sexes. Notes are also given on the morphology and circumstances of collection of four species, one of them new, of which material of both sexes from Panama was examined by the authors, and the literature on *P. squamiventris* Lutz & Neiva is reviewed and discussed in the light of a study of a male and 50 female specimens, probably of this species, from Colombia, which are described and figured. The others are placed in the keys on the basis of published descriptions only.

In the second paper, *Warileya rotundipennis*, sp. n., and *W. nigrosacculus*, sp. n., are described from both sexes and from one female, respectively, taken in Panama. Females of the former were biting man. The genus is recharacterised [*cf.* **39** 9], as examination of the new species showed that some of the more outstanding characters of the type species have only specific value.

Hill (E. L.), Morlan (H. B.), Utterback (B. C.) & Schubert (J. H.). **Evaluation of county-wide DDT Dusting Operations in Murine Typhus Control (1946 through 1949).**—*Amer. J. publ. Hlth* **41** no. 4 pp. 396–401, 3 figs., 8 refs. New York, N.Y., 1951.

Morlan (H. B.) & Hines (V. D.). **Evaluation of county-wide DDT Dusting Operations in Murine Typhus Control, 1950.**—*Publ. Hlth Rep.* **66** no. 33 pp. 1052–1057, 2 figs., 4 refs. Washington, D.C., 1951.

In these two papers, data are given on the duration of the effect of dusting rat runs and harbourages with 10 per cent. DDT on a county-wide basis

against ectoparasites of rats as a measure against endemic (murine) typhus. The dusting was carried out in two counties in Georgia in 1946 and 1947 [*R.A.E.*, B **39** 108].

In the first paper, the experiment is briefly described and the results up to the end of 1949 are given. The significant suppression of murine typhus in man that followed dusting persisted throughout that period, and the prevalence of typhus complement-fixing antibodies in the rats in the treated counties was still low in 1949, though it showed a marked upward trend. *Xenopsylla cheopis* (Roths.) and *Leptopsylla segnis* (Schönh.), which had been reduced to a low population level in 1947, recovered somewhat in 1948 and 1949 but were still much less plentiful than in the untreated control county. *Polyplax spinulosa* (Burm.) was as plentiful as in the untreated county by June 1948, and *Liponyssus bacoti* (Hirst) was nearly back to normal abundance in 1949.

In the second paper, the results to the end of 1949 are briefly recapitulated and observations made in July and August 1950 are recorded. The percentage of rats infested with *X. cheopis* showed a further rise but was still less than half of that in the control county. *Leptopsylla segnis* was much scarcer than in the control county, but the summer is not a time of abundance for this species. The percentage of rats positive in the typhus complement-fixation test again tended to rise slightly. An appreciable degree of suppression of typhus in man was maintained. It is concluded that effective control persisted for the three years of the observation period.

In both papers, factors that may have accounted for the achieving of better results in one treated county than the other are suggested. They are all related to greater thoroughness or the timing of treatments.

Radeleff (R. D.), Claborn (H. V.), Beckman (H. F.), Wells (R. W.) & Bushland (R. C.). **Toxaphene Residues in Fat of sprayed Cattle.**—*Vet. Med.* **46** no. 8 pp. 305–308, 6 refs. Chicago, Ill., 1951.

An account is given of experiments in Texas on the extent to which toxaphene applied to cattle in sprays under conditions simulating treatment against ticks or horn flies [*Siphona irritans* (L.)] is accumulated in the fat [*R.A.E.*, B **39** 81]. The analytical method is described. An emulsion concentrate consisting of 50 per cent. toxaphene, 35 per cent. kerosene and 15 per cent. emulsifier, diluted with water to give a concentration of 0·5 per cent. toxaphene, was used for all sprays. Steers kept on a moderately fattening diet were sprayed repeatedly to saturation at intervals of two weeks without accumulating large amounts of toxaphene, as indicated by organic-chloride analysis, in their omental fat and without damage to the internal cellular structure of the body. In animals sprayed once, there was no significant increase in organic chlorides in fat taken two days, two weeks or four weeks after treatment. In animals sprayed two, three, four and six times at intervals of two weeks, there was a considerable increase in the organic-chloride content of fat taken two weeks after the last spraying. The content returned to the pre-treatment level after 18, 14, 10 and 6 weeks, respectively. However, in view of considerable variation in the normal chloride content of control animals, the significance of the results is doubtful. Animals sprayed eight, ten and twelve times showed no increase in organic chlorides two weeks after the last spraying.

Todd (A. C.), Hansen (M. F.), Smith (M. F.) & Brown (R. G.). **Action of Methyl Benzene (Toluene) against Horse Bots.**—*J. Amer. vet. med. Ass.* **116** no. 878 p. 369. Chicago, Ill., 1950.

Observations in Kentucky of the effect of toluene on larvae of *Gasterophilus* [*cf. R.A.E.*, B **39** 186], made during tests in which it was being applied as an ascaricidal agent in horses, indicated that it was more effective against

G. intestinalis (Deg.) than against *G. nasalis* (L.). At postmortem examination of the first 11 horses, which had received toluene by stomach tube 24 hours earlier at 0·1 ml. per lb. body weight, it was found that a high percentage of *G. intestinalis* larvae had been expelled from the stomach. Numbers of *G. nasalis* were still attached in the pyloric region, although the finding of larvae in the large intestine indicated some action against this species also. In two special tests, 0·1 and 0·2 ml. toluene, respectively, per lb. body weight were administered to two mares on full feed, and postmortem examinations were again made 24 hours later. In the mare that had received the smaller dose, 19 living larvae of *G. nasalis* and three of *G. intestinalis* were found attached in the stomach in the regions they usually infest, and a few larvae of *G. nasalis* and 53 dead larvae of *G. intestinalis* were recovered from the contents of the large intestine. In the other mare, 35 living *G. nasalis* were recovered from the stomach and 6 from the small intestine, where they were attached to the mucosa, and 30 living and 61 dead larvae of the same species and 105 dead larvae of *G. intestinalis* were found in the large intestine.

Papers noticed by Title only.

del Ponte (E.), Castro (M. P.) & García (M.). **Clave para las especies de *Psorophora* y *Aëdes* de la Argentina y comarcas vecinas. Diagnosis de *Aëdes* (*O.*) *raymondi* n. sp. (Diptera, Culicidae).** [Key to the Species of *Psorophora* and *Aëdes* of Argentina and neighbouring Territories. Description of *A.* (*Ochlerotatus*) *raymondi*, sp. n.]—*An. Soc. cient. argent.* **151** pt. 5 pp. 228–243, 17 refs. Buenos Aires, 1951. (With Summaries in Portuguese and English.)

Thompson (G. B.). **Ticks of Jamaica, B.W.I. Records and Notes (including a Summary of the Distribution of the West Indian Species).**—*Ann. Mag. nat. Hist.* (12) **3** no. 27 pp. 220–229, 4 refs. London, 1950.

Hawes (I. L.). **Index VIII to the Literature of American Economic Entomology January 1, 1945 to December 31, 1947.**—*Spec. Publ. Amer. Ass. econ. Ent.* no. 8 [9+]805 pp. College Park, Md., 1951. Price $7.00. [*Cf. R.A.E.*, B **38** 40.]

Richards (A. G.). **The Integument of Arthropods : the chemical Components and their Properties, the Anatomy and Development, and the Permeability.** —9¼×6 ins., xvi+411 pp., 65 figs., 77 pp. refs. Minneapolis, Minn., Univ. Minn. Pr. ; London, G. Cumberlege, Oxford Univ. Pr., 1951. Price $6 or £2 8*s*. [See *R.A.E.*, A **40** 292.]

Florey (E.). **Untersuchungen über den Wirkungsmechanismus von Insektiziden.** [Investigations on the Mechanism of Action of Insecticides.]—*Pflanzenschutzberichte* **6** pt. 9–10 pp. 134–152, 8 figs., 20 refs. Vienna, 1951. (With a Summary in English.) [See *R.A.E.*, A **40** 312.]

Chang (Peh-I). **The Action of DDT on the Golgi Bodies in Insects nervous Tissue.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 311–326, 13 figs., 52 refs. Columbus, Ohio, 1951. [See *R.A.E.*, A **40** 292.]

Roeder (K. D.) & Weiant (E. A.). **The Effect of DDT on sensory and motor Structures in the Cockroach Leg.**—*J. cell. comp. Physiol.* **32** no. 2 pp. 175–186, 2 figs., 11 refs. Philadelphia, Pa., 1948. **The Effect of Concentration, Temperature, and Washing on the Time of Appearance of DDT-induced Trains in sensory Fibers of the Cockroach.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 372–380, 3 figs., 6 refs. Columbus, Ohio, 1951. [See *R.A.E.*, A **40** 292.]

Konst (H.) & Plummer (P. J. G.). **Acute and chronic Toxicity of Parathion to warm-blooded Animals.**—*Canad. J. comp. Med.* **14** no. 3 pp. 90–108, 5 refs. Quebec, 1950. [See *R.A.E.*, A **40** 293.]

SERGENT (Ed.). **Essais de destruction des varrons d'*Hypoderma bovis* par l'administration orale de l'insecticide H.C.H. (Hexachlorocyclohexane).**—*Arch. Inst. Pasteur Algérie* **29** no. 2 pp. 125–128, 1 graph, 3 refs. Algiers, 1951.

Benzene hexachloride in water suspension was administered by mouth to six calves infested with larvae of *Hypoderma bovis* (Deg.) ; one calf received 0·3 gm. technical benzene hexachloride per kg. body weight in a single dose and five others received 0·25 gm. per kg. All calves showed symptoms of poisoning and the one that received the larger dose and three of the others died [*cf. R.A.E.*, B **37** 58]. The two calves that survived recovered completely from the poisoning in two and three days, respectively, but observations continued over a period of three months showed that the treatment had no effect on the course of the infestation as compared with that in six untreated control calves.

PARROT (L.). **Notes sur les phlébotomes. LXII. *Phlebotomus dubius*, *Phlebotomus antennatus* var. *cinctus* et leur distribution géographique.**—*Arch. Inst. Pasteur Algérie* **29** no. 2 pp. 129–133, 2 figs., 15 refs. Algiers, 1951.

The author agrees with Kirk & Lewis [*R.A.E.*, B **40** 125] in regarding *Phlebotomus cinctus* Parr. & Martin as a variety of *P. antennatus* Newst., but considers that *P. signatipennis* Newst. is a synonym of typical *P. antennatus* and that *P. dubius* Parr., Morn. & Cad. is a distinct species because of differences in the buccal armature of the female and the shape of the wing of the male. Rearing experiments are considered necessary to define whether *P. antennatus* var. *occidentalis* Thdr. should be accorded the status of a distinct variety.

Notes are given on the distribution of *P. antennatus* var. *cinctus* and *P. dubius*, both of which appear to be much less common and less widely distributed over Africa than typical *P. antennatus*.

DU TOIT (R.) & GOOSEN (P. J.). **D.D.T. for the Protection of Sheep against Blowfly Strike.**—*Onderstepoort J. vet. Sci.* **22** no. 2 pp. 285–290, 6 refs. Pretoria, 1949.

Observations in a game reserve in Zululand showed that all the species of blowflies that occur in the wool-producing areas of South Africa, including *Lucilia cuprina* (Wied.), the principal species infesting sheep, can maintain themselves where sheep are absent. In view of this and the fact that blowflies are beneficial in destroying carrion and pollinating certain economic plants, it appeared that measures against them as pests of sheep should be directed to protecting the sheep rather than to attempting extermination of the flies. Experiments on the value of DDT for this purpose were therefore carried out in the laboratory at Onderstepoort and in the field in the Graaff Reinet district of the Karroo. When sheep were treated on selected sites with 2·5 and 5 per cent. p,p'DDT in an emulsified solution and first-instar larvae were put on the treated sites, development of the larvae was prevented for about three months. In the field experiments, sheep were treated by spraying the emulsified solutions at concentrations giving 2·5, 5 or 6 per cent. p,p'DDT into the wool around the root of the tail and the whole breech region. The heads of rams and the preputial region of rams and wethers were also treated. In all, 1,866 sheep were treated in 17 experiments and 11·5 per cent. became infested as compared with 34·8 per cent. of 2,958 untreated controls. Infestation was reduced in 15 of the experiments, but the extent of the reduction, though often great, was not related to the strength of the spray. Uneven rainfall was probably responsible for the varying results. Protection was more apparent in sheep pastured on Karroo veld than in those grazing on lucerne lands. Most of the infestations

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on treated sheep were small and showed little tendency to spread. It is concluded that treatment of sheep with 5 per cent. p,p'DDT by the method described will give enough protection to reduce infestation to a minimum during the periods of greatest fly activity. Treatment is best applied shortly after the first summer rains about September and again after the late summer rains in February.

THEILER (G.). **Zoological Survey of the Union of South Africa. Tick Survey. Part I. Distribution of** *Amblyomma hebraeum*, **the Heartwater Tick.**—*Onderstepoort J. vet. Sci.* **23** no. 1–2 pp. 217–231, 4 fldg. maps. Pretoria, 1948. **Part II. Distribution of** *Boophilus* (*Palpoboophilus*) *decoloratus*, **the Blue Tick.**—*Op. cit.* **22** no. 2 pp. 255–268, 1 fldg. map. 1949. **Part III. Distribution of** *Rhipicephalus appendiculatus*, **the Brown Tick.**—*T.c.* pp. 269–284, 1 fldg. map. **Part IV. Distribution of** *Rhipicephalus capensis*, **the Cape Brown Tick.**—*Op. cit.* **24** no. 1–2 pp. 7–32, 1 fldg. map, 5 fldg. tables. 1950. **Part V. Distribution of** *Rhipicephalus evertsi*, **the Red Tick.** —*T.c.* pp. 33–36, 1 fldg. map. **Part VI. Distribution of the Ixodids :** *Ixodes pilosus* **and** *Ixodes rubicundus*.—*T.c.* pp. 37–51, 1 fldg. map.

It is stated in the introduction to the first part or in the preface by P. J. du Toit that this survey is based on collections of ticks from domestic animals made throughout the Union of South Africa according to standard instructions at different times of the year by Government Veterinary Officers and forwarded to Onderstepoort between September 1937 and June 1944. The collections were supplemented by material submitted for identification by farmers. The survey is designed to establish the ecological habitat and the limiting factors in the environment of species of economic importance. Classification is kept as simple as possible, subspecific and geographic variations being ignored. Major vegetational zones, average yearly rainfall and the average length of yearly frost periods are shown on maps appended to the first part. Though vegetation can be taken as a summation of the climatological and physiographical factors of a locality and has undoubtedly an important influence on the life of a tick, it is not necessarily the limiting factor. In each part, the distribution of the tick concerned is set out in terms of political divisions and of vegetational zones and is shown on a map of either vegetation or rainfall.

The following is based on the author's summaries. *Amblyomma hebraeum* Koch is present in the parklands and in the bushveldt of the areas of summer rainfall, where the bush coverage offers adequate shelter. It is absent from the more arid bushveldt regions even though the bush shelter would be adequate. The most important factor limiting the spread of *Boophilus decoloratus* (Koch) is increasing aridity. An annual rainfall of 15 ins. is critical in most parts of the Union. It is considered that where farming conditions are favourable, both these ticks could be controlled by dipping. No definite conclusions are drawn from the data available on the distribution of the arsenic-resistant strain of *B. decoloratus* [*R.A.E.*, B **35** 64], but it apparently occurs on scattered farms throughout the tall grassland areas extending as far north as Swaziland.

Rhipicephalus appendiculatus Neum. is present in areas with a yearly rainfall of more than 15 ins., provided the bush or scrub coverage is adequate. It is absent from areas with more than 15 ins. of rain but no bush. A brown tick present in the " brokenveldt " of Fauresmith in the Kimberley area is either a variety or subspecies of *R. appendiculatus* or a strain of the species that has become resistant to drought. *R. appendiculatus* can be eradicated from areas where farming conditions are favourable and movement of wild life is restricted. *R. capensis* Koch tends to be inactive in April, May and June, independently of whether this is the coldest, wettest or driest part of the year. From the data available, it was impossible to establish a behaviour pattern for this species. The factors limiting its distribution are also difficult to establish. Extreme

heat and extreme cold do not affect it. Humidity alone, in terms of precipitation, does not play an important part, but humidity associated with plant coverages does appear to exert an influence. *R. capensis* can apparently support much greater aridity in scrub country (Karrooveldt) than it can in grass veldt. It is seldom, if ever, present in the open veldt of short or mixed grasslands. In the tall grass lands, it apparently occurs only in the moister areas. In the eastern tall grass lands, disturbances in the distribution pattern may be ascribed to dipping. *R. evertsi* Neum. is present in all forest, parkland and grassland areas with a rainfall above 10 ins. It is absent from all Karroo areas with rainfall below 10 ins. It appears to maintain itself precariously in mixed Karroo scrub and grassland areas with a rainfall between 10 and 15 ins. It shows no essential periodicity in its activities. It is not controlled by dipping alone. Hand-dressing in addition to dipping is essential for its suppression.

Ixodes pilosus Koch appears to be associated with sour-veldt, which, in its turn, is mainly associated with high rainfall. From the data available, it is difficult to establish which factors influence the activities of the tick or limit its distribution. It may be present in most seasons in most areas. The data available suggest that it can be controlled with the usual arsenical dips. *I. rubicundus* Neum. is confined to the moister regions of the Karrooveldt, regions that are generally hilly or mountainous rather than flat and open. It is active in the early winter months of April and May, occasionally until July, but very rarely in the summer. As it occurs in areas where dipping is not practised, it is impossible to conclude from the data what effect dipping has on it. It sometimes causes paralysis in sheep and is the only tick so far known to cause tick paralysis in South Africa [*cf.* **32** 18, etc.].

Evans (J. W.). **The injurious Insects of the British Commonwealth (except the British Isles, India and Pakistan), with a Section on the Control of Weeds by Insects.**—10×7 ins., vii+242 pp., frontis. London, Commonw. Inst. Ent., 1952. Price 30*s.*

This book deals primarily with agricultural pests and is noticed in more detail elsewhere [*R.A.E.*, A **40** 327], but the first part (pp. 1–37), which contains information on the physical features, climate and crops of each country of the British Commonwealth, excluding the British Isles, India and Pakistan, also includes notes on the insects and other arthropods that affect the health of man or stock, designed solely to provide information of a general nature for workers in other fields of entomology.

Kühl (R.). **Die Bedeutung von γ-Hexachlorcyclohexan für die Bekämpfung der Tierräuden.** [The Importance of γ Benzene Hexachloride for the Control of Mange in Animals.]—*Z. angew. Ent.* **32** pt. 4 pp. 576–590, 3 figs., refs. Berlin, 1951.

Following promising laboratory investigations, field tests were begun in Germany in 1946 on the use of BHC (benzene hexachloride) in dips against *Psoroptes* [*ovis* (Hering)] on sheep. Emulsified solutions proved superior to suspensions, and it was found that a dip containing at least 0·01 per cent. γ BHC at a temperature of 35°C. [95°F.] gave complete mortality of the mites. Two suitable liquid concentrates were developed commercially and widely used, with good results. The quality of the wool was not impaired by the treatment, and there were no harmful effects on the sheep except a few cases of otitis due apparently to bacterial infection from contaminated dips, the temperature of which had fallen to 25°C. [77°F.]. These were eliminated by the addition of suitable antiseptics to the concentrates. A mobile apparatus that proved effective for dipping the animals is described ; it included a circular bath with a

heating unit in the centre, round which the sheep had to swim. The dips also controlled lice, ticks and *Melophagus* [*ovinus* (L.)], and tests indicated that they would protect sheep from reinfestation by *Psoroptes* and the insects for about 50 and 90 days, respectively.

Holz (W.). **Versuche zur Wanzenbekämpfung mit dem Bayer-Präparat E 605.** [Experiments in Control of Bugs with the Bayer Preparation E 605.]—*Anz. Schädlingsk.* **21** pt. 9 pp. 138–139. Berlin, 1948.

Excellent control of bed-bugs [*Cimex lectularius* L.] in buildings in Germany in which sulphur fumigation had been ineffective was obtained by the combined use of E 605 f [an emulsion concentrate containing 70 per cent. parathion] and E 605 Staub [a dust of 2 per cent. methyl-parathion in an inert carrier]. Food, cooking utensils and bedding were removed from the rooms, and these and the remaining contents were then sprayed with 0·1 per cent. E 605 f at the rate of approximately 4 pints per 100 sq. ft. Bedding material was treated at the same time with the dust. The rooms were kept closed for 1–2 hours while the spray dried and were then thoroughly ventilated, and the inhabitants were allowed to return an hour later. Most of the bugs were dead on the first, and all on the third day after treatment, and the rooms remained free from infestation for several months. Infestation by fleas also ceased promptly, and the number of flies present was considerably reduced for a month.

March (R. B.). **The Resolution and chemical and biological Characterization of some Constituents of technical Chlordane.**—*J. econ. Ent.* **45** no. 3 pp. 452–456, 3 figs., 9 refs. Menasha, Wis., 1952.

The following is substantially the author's summary. By means of chromatographic adsorption techniques, technical chlordan was separated into four physically, chemically and biologically distinct crystalline constituents and an unknown liquid mixture. The four distinct constituents are postulated to be : 4,5,6,7,8,8-hexachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene ; 1 (or 3a), 4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene ; and the cis and trans isomers of 2,3,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene. It did not appear that endo-exo isomer pairs were present, and it was not determined whether the isomers obtained were endo or exo. Higher chlorinated derivatives were not found in the sample of technical chlordan tested. Compounds identical with the second, third and fourth constituents have been commercially synthesised in pure form. They are known as heptachlor and the α and β isomers of chlordan.

Topical application of the toxicants dissolved in dioxane to the scutella of adult females of *Oncopeltus fasciatus* (Dall.) showed that the dosages giving 50 per cent. mortality in 96 hours were 143±2 mmg. per gm. average insect weight for technical chlordan, more than 1,000, 31±1, 459±14 and 47±1 mmg. per gm. for the four crystalline constituents in the order listed and 232±7 for the liquid mixture.

Sternburg (J.) & Kearns (C. W.). **Metabolic Fate of DDT when applied to certain naturally tolerant Insects.**—*J. econ. Ent.* **45** no. 3 pp. 497–505, 8 refs. Menasha, Wis., 1952. **Chromatographic Separation of DDT and some of its known and possible Degradation Products.**—*T.c.* pp. 505–509, 5 refs.

It is shown by the experiments described in the first paper, which are noticed in more detail elsewhere [*R.A.E.*, A **40** 347], that *Melanoplus differentialis* (Thos.), *M. femur-rubrum* (Deg.) and larvae of *Epilachna varivestis* Muls. and *Eulia* (*Argyrotaenia*) *velutinana* (Wlk.) can all degrade oral and topical doses of DDT to DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene), as do

resistant strains of *Musca domestica* L. [B **39** 211, etc.], and that *Epilachna* further converts DDE to an unidentified compound or compounds.

By the Schechter-Haller colorimetric method for the quantitative determination of DDT and its analogues [*cf.* B **35** 196], p,p′DDT yields an intense blue colour, whereas various analogues, either known or theoretically possible as metabolites, yield red colours, with the result that they cannot be differentiated from one another. A method of separating them by the use of a succession of solvents is described in the second paper, the compounds considered being DDE, DDA [bis(p-chlorophenyl) acetic acid], 4,4′-dichlorobenzophenone, 4,4′-dichlorobenzhydrol, bis-p-chlorophenyl methane and p-chlorobenzoic acid. The last four of these are theoretically possible as metabolites, but have not been identified in insect tissues.

DDE appears to be the principal metabolite of DDT produced by insects, but others are known, of which one of unknown composition also produces a red colour in the test. A metabolite behaving like dichlorobenzhydrol has been isolated from *Sarcophaga crassipalpis* Macq. and *Periplaneta americana* (L.), but not specifically identified owing to the presence of interfering materials from insect tissue. The conversion of DDT to DDA, the principal metabolic end product of DDT in vertebrates, appears to be of minor importance in insects, the only report of its presence, in a DDT-resistant strain of *Musca domestica* [B **38** 209], being probably due to experimental error.

The procedures described have been found adaptable to the study of DDT metabolism in *M. domestica, Blattella germanica* (L.), *P. americana, Melanoplus differentialis, M. femur-rubrum, Epilachna varivestis, Eulia velutinana* and *S. crassipalpis*. DDT and its metabolites are extracted with diethyl ether from up to 2 gm. ground insect tissue [*cf.* B **38** 209]. If the presence of DDA or p-chlorobenzoic acid is suspected, the sample is first acidified and alkaline extraction is used to remove them. They can then be determined by the Schechter-Haller method. However, if it can be shown that they are absent from a given species of insect, this step may be omitted in subsequent experiments with that species. The remaining solvent is washed to remove traces of alkali, which would interfere with later determinations, and evaporated from the insect extractive. The residue is taken up in petroleum ether and introduced into a column of activated alumina, and more petroleum ether is passed through the column and collected in a flask. This eluate will contain any DDE present. Carbon tetrachloride is then passed through the column into another flask to collect any DDT, followed by benzene to collect 4,4′-dichlorobenzophenone, and diethyl ether or acetone to collect 4,4′-dichlorobenzhydrol. The solvents are carefully evaporated from the four eluates, and analyses made by the Schechter-Haller method. Bis-p-chlorophenyl methane, if present, will appear with DDE in the petroleum-ether eluate, but if the residue is refluxed in ethylene glycol and potassium hydroxide to convert DDE to DDA and the reaction mixture extracted with diethyl ether, the methane can be separated from the water-soluble potassium salt of DDA, and both can be determined by the Schechter-Haller method ; this step may ordinarily be omitted.

Fat from 2 gm. insect tissue does not interfere with the separation, and DDT and DDE are isolated almost free of fat. Recoveries of small quantities of these range from 90 to 100 per cent., and those of 4,4′-dichlorobenzophenone and 4,4′-dichlorobenzhydrol, though occasionally low, are generally better than 90 per cent.

RADELEFF (R. D.), BUSHLAND (R. C.) & HOPKINS (D. E.). **Phosphorus-32 Labeling of the Screw-worm Fly.**—*J. econ. Ent.* **45** no. 3 pp. 509–514, 4 refs. Menasha, Wis., 1952.

An account is given of experiments on the marking of adults of *Callitroga hominivorax* (Coq.) (*americana* (Cush. & Patt.)) with radioactive phosphorus

(P^{32}) [*cf. R.A.E.*, B **39** 181] with a view to using this as a means of distinguishing released flies in field tests of the possibility of reducing natural populations through the release of larger numbers of sterilised individuals [*cf.* **40** 43]. As it was thought that release would be best accomplished by distributing pupae and allowing the flies to emerge normally, the phosphorus was administered to the larvae. It was in the form of phosphoric acid. The equipment used for measuring radiation is described. Counting rates on emergence of flies from larvae reared in artificial medium [**29** 83] ranged from 323 counts per minute per fly when the medium had contained 0·01 microcurie P^{32} per gm. to 260,281 c.p.m. per fly when it had contained 8 microcurie per gm. The observations were continued throughout the adult life of the flies, and it appeared that rearing throughout the larval stage in medium containing 0·2 microcurie per gm. would provide uniformly marked flies with adequate counting rates. When larvae were transferred from treated to untreated medium after three days, 0·5 microcurie per gm. or more produced effectively labelled flies, but transfer from untreated to treated medium after three days gave erratic labelling because the larvae completed feeding in periods ranging from 24 to 60 hours after transfer. Rearing experiments on a larger scale showed that there was no difference in egg-laying capacity, fertility or length of life between flies reared on untreated medium and flies reared on media containing 0·2, 0·5 or 1 microcurie P^{32} per gm. In treated larvae, phosphorus was largely concentrated in the fat-body, muscles and digestive tract, and in flies in the abdomen and thorax, with less in the head, still less in the legs and very little in the wings. It was possible to determine by radioactivity whether or not masses of eggs or larvae were the progeny of flies reared on a medium containing 0·05 microcurie P^{32} per gm. or more.

Newly hatched larvae placed in wounds on a sheep and two goats that had received 0·1 microcurie P^{32} intravenously per gm. body weight on the previous day as dilute phosphoric acid and on one goat that had received 0·06 microcurie per gm. developed normally and gave rise to flies with substantial counting rates. Flies from the sheep had higher rates than flies from goats. However, the large amount of P^{32} needed to produce even moderate marking of the comparatively small number of adults obtained makes this procedure too expensive for use except in special studies.

LEWALLEN (L. L.). **Laboratory Studies of the False Stable Fly.**—*J. econ. Ent.* **45** no. 3 pp. 515–517, 10 refs. Menasha, Wis., 1952.

When *Muscina stabulans* (Fall.) was reared at about 80°F. and 60 per cent. relative humidity by a method modified from one used for house-flies (*Musca domestica* L.) [*cf. R.A.E.*, B **37** 89], the life-cycle from egg to egg occupied 20–25 days. Four generations were reared successfully, but the flies then failed to oviposit. In comparative tests of the resistance to DDT, lindane [containing at least 99 per cent. γ benzene hexachloride] or methoxy-DDT (methoxychlor) of adults of *Musca domestica* collected at a dairy in California where resistance to these insecticides was known to have developed, the progeny of *Muscina stabulans* collected from the same dairy and a non-resistant laboratory strain of *Musca domestica*, the median lethal topical doses in mmg. per female fly for the resistant house-flies, the non-resistant house-flies and *Muscina stabulans* were 9·5, 0·033 and 0·027 for DDT, 0·13, 0·01 and 0·0041 for lindane, and 1·3, 0·068 and 0·014 for methoxy-DDT. Possible reasons for the extremely high susceptibility of the *Muscina stabulans* from a source where it might have been expected to develop resistance are discussed.

GERSDORFF (W. A.) & MITLIN (N.). **Relative Toxicity to House Flies of Scabrin and its Mixtures with some Pyrethrum Synergists.**—*J. econ. Ent.* **45** no. 3 pp. 519–523, 6 refs. Menasha, Wis., 1952.

It has recently been shown that three American species of *Heliopsis* contain material toxic to *Musca domestica* L., extractives of the root of *H. scabra* being particularly effective [*R.A.E.*, A **39** 122]. A toxic substance named scabrin has been isolated from these roots and shown to be the N-isobutylamide of an unsaturated 18-carbon straight-chain acid or a mixture of isomers [B **40** 15]. Scabrin, particularly at high concentrations, appears to be less stable in kerosene than are pyrethrins, kerosene sprays containing it losing their toxicity after some days. An account is given of experiments designed to determine the toxicity to *M. domestica* of kerosene sprays containing purified scabrin alone or with the addition of certain pyrethrum synergists. Pyrethrum sprays prepared from an extract of which the total pyrethrins contained 54 per cent. pyrethrin I and cinerin I were used as the standard of comparison. Tests were made by the turntable method [B **26** 246].

The following is based on the authors' summary of the results, which are given in tables. The toxicity of scabrin increased more rapidly with increase in concentration than did that of pyrethrins. The two were about equally toxic at the 25 per cent. mortality level, but at the 90 per cent. mortality level, scabrin was about 1·6 times as toxic as pyrethrins. The joint action in mixtures containing ten times as much adjunct as scabrin was of the synergistic type with n-octyl sulphoxide of isosafrole, piperonyl butoxide, piperonyl cyclonene, n-propyl isome, 3,4-methylenedioxybenzyl n-propyl ether and synergist 264 (N-octyl bicycloheptene dicarboximide), which are named in order of decreasing intensity of synergism. At the 50 per cent. mortality level, the mixtures containing n-octyl sulphoxide of isosafrole and synergist 264 were, respectively, 4·2 and 1·5 times as toxic as scabrin alone on the basis of scabrin equivalent and 4·9 and 1·8 times as toxic on the basis of actual scabrin. No synergism was demonstrated in a mixture containing 50 times as much D.H.S. Activator (ethylene glycol ether of pinene) as scabrin. The mixtures containing n-octyl sulphoxide of isosafrole and piperonyl butoxide still maintained their high level of effectiveness after 29 weeks. The knockdown of flies caused by all mixtures was high. Scabrin alone was nearly as effective in this respect as pyrethrins.

ROTH (A. R.), LINDQUIST (A. W.) & MOTE (D. C.). **Incidence and Habits of Tabanidae at Summer Lake, Oregon.**—*J. econ. Ent.* **45** no. 3 pp. 527–531, 4 refs. Menasha, Wis., 1952.

Data are given on the abundance, distribution and biting habits of five Tabanids that are troublesome to livestock in the Summer Lake Valley, Oregon. *Chrysops discalis* Will. is the most plentiful [*cf. R.A.E.*, B **35** 97 ; **37** 205], but is found chiefly in areas near the main lake. It bites animals on any part of the body and attacks man freely, biting even through a light-weight jacket, but it is less persistent than other species. *C. bishoppi* Brennan, which is much less abundant, is most common in the foothill area. It is persistent and attacks any part of an animal, but seldom bites man. *Tabanus sonomensis* O.-S. persistently bites the back, sides and face of animals and attacks man with equal ferocity ; *T. productus* Hine prefers to attack animals on the legs and under the belly and does not usually attempt to bite man except below the knees ; *T. punctifer* O.-S. attacks livestock, preferably on the back.

Average numbers of flies counted on one side of cows and calves under different conditions are given. They were highest on calves in July when the numbers of *C. discalis*, *T. productus* and *T. sonomensis* seen per calf in 10 seconds were

40, 20 and 9 on one ranch and 30, 30 and 50 on another. An average of about 14 *Chrysops* was observed alighting on an animal to each one biting. A calf penned inside a screen-wire trap attracted 400 *C. discalis* and 27 *Tabanus* spp. in an hour. Rabbits attracted very few Tabanids.

A rotating aerial trap operated in 1949 and 1951 consistently caught more males of *C. discalis* during the morning than during the afternoon, but on the few occasions on which the trap was operated after 5 p.m. the number of males rose again. The number of females caught did not show a consistent relationship with temperature or time of day. Other studies with the trap showed *C. discalis* to be the dominant Tabanid on alkali flats near the lake and *T. sonomensis* in irrigated pastures. The greatest numbers of *C. discalis* and *T. sonomensis* caught in an hour were 333 and 124, respectively. Mature eggs were found in 98 of 100 females of *C. discalis* caught on adhesive-treated stakes set on the shore line and in only 1 of 100 netted over grass on alkali flats. Eggs of *T. sonomensis* have not been found in nature, and of 641 females collected in 30 days only 10 contained mature eggs.

Pellegrini jr. (J. P.), Miller (A. C.) & Sharpless (R. V.). **Biosynthesis of radioactive Pyrethrins using $C^{14}O_2$.**—*J. econ. Ent.* **45** no. 3 pp. 532–536, 3 figs., 6 refs. Menasha, Wis., 1952.

The authors describe a method, noticed in more detail elsewhere [*R.A.E.*, A **40** 349], of obtaining radioactive pyrethrins by growing pyrethrum plants for several weeks in an atmosphere containing radioactive carbon dioxide ($C^{14}O_2$) and isolating and purifying the pyrethrins from the C^{14}-labelled flowers. Tests showed that the pyrethrins had the expected insecticidal activity against house-flies [*Musca domestica* L.] and cockroaches and that they were labelled with C^{14} in both alcohol and acid portions of the molecules at levels high enough for qualitative and quantitative determinations.

Fulton (R. A.), Gelardo (R. P.) & Sullivan (W. N.). **Relative Efficiency of Methods of applying Lindane in enclosed Spaces.**—*J. econ. Ent.* **45** no. 3 pp. 540–541, 2 refs. Menasha, Wis., 1952.

As it has been shown that the vapour from an aerosol or spray deposit of lindane [at least 99 per cent. γ benzene hexachloride] is toxic to insects in enclosed spaces [*R.A.E.*, B **38** 209], experiments were made in 1951 to determine the concentration of vapour built up after application of lindane by four different methods. Four airtight chambers, each with a capacity of 3,000 cu. ft., were used. The walls and ceiling of one were sprayed once at 25 mg. lindane per sq. ft. with a suspension made from a water-dispersible powder containing 25 per cent. lindane. The second was provided with an air-circulating device [**39** 140] by means of which the air was blown continuously through a Fiberglas filter that had been sprayed with an acetone solution of lindane. The third was treated with an electrically heated vaporiser set to operate continuously and maintain the temperature of the lindane at 113–116°C. The fourth was treated weekly with a solution of lindane propelled by carbon dioxide at 300 mg. lindane per 1,000 cu. ft. The composition of the solution was 1 per cent. lindane, 50 per cent. cyclohexanone, 45 per cent. acetone and 4 per cent. carbon dioxide.

Air was analysed and mortality of house-flies (*Musca domestica* L.) exposed to the vapour was noted periodically by methods used in the earlier work [**38** 209]. The quantities of lindane in the air in mg. per 1,000 cu. ft. 1 hour and 1, 6, 15 and 21 days after treatment and (in brackets) the percentage mortalities of house-flies in 60 minutes were 4·8 (99), 21·8 (97), 7·4 (99), 2·4 (27) and 0·96 (28) with the suspension spray ; 4·8 (100), 11·9 (100), 17 (100), undetermined (99) and 11·9 (76) with the screen and fan ; and 4·8 (51), 19·5

(32), 5·9 (100), 0·96 (20) and an undetermined amount (9) with the vaporiser. With the solution, there was 11·9 mg. lindane per 1,000 cu. ft. after 1 hour and 5 days, an undetermined amount after 6 days and 1·4 mg. after 8 days, and percentage mortalities after these periods were 100, 31, 64 and 42. Despite the small amount applied, the solution left a deposit on the walls and ceiling that was effective for 5–8 days. The deposit from the suspension was visible for about two weeks, after which it was obscured by dust and vapour concentration fell. The treated screen also became coated with dust after a short time, and for maximum efficiency should be protected by a dust filter.

Sullivan (W. N.). **Tests with Lindane Vapor for freeing Aircraft from Insects.**—*J. econ. Ent.* **45** no. 3 pp. 544–545, 14 refs. Menasha, Wis., 1952.

An account is given of tests showing that mosquitos in aeroplanes can be killed by vapour from lindane [at least 99 per cent. γ benzene hexachloride] sprayed on a Fiberglas filter [*cf. R.A.E.*, B **39** 140], which is placed in the air-conditioning system. A five-passenger aeroplane with a cabin capacity of 120 cu. ft. was used, and 8·3 gm. lindane was sprayed on two 4×8×1-inch sections of a filter, which were then placed back to back and mounted to cover the outlet of the air-conditioning system. The aeroplane was flown at 150 miles per hour with a cabin temperature of 56–85°F. Free-flying and caged insects were exposed for 20 or 30 minutes and then kept for 24 hours. All mosquitos (*Culex pipiens* L. and *Aëdes aegypti* (L.)) were killed. Kill of house-flies (*Musca domestica* L.) ranged from 76 per cent. when the filter was in a ventilator admitting air from outside to 93 or 100 when it was in a recirculating unit. Insects that died were usually knocked down within an hour. Agricultural pests were not affected.

The method described is simple and automatic, the equipment needed weighs only a few ounces and the vapour has the penetrating properties of a fumigant, leaves no visible deposit and is invisible to the passengers. The effect of lindane vapour on people has not yet been determined.

Yates (W. W.), Lindquist (A. W.) & Butts (J. S.). **Further Studies of Dispersion of Flies tagged with Radioactive Phosphoric Acid.**—*J. econ. Ent.* **45** no. 3 pp. 547–548, 2 refs. Menasha, Wis., 1952.

To obtain further information on dispersal [*cf. R.A.E.*, B **39** 168], 60,000 adults of *Phormia regina* (Mg.), 54,000 of *Musca domestica* L. and 700 of *Lucilia* (*Phaenicia*) sp. that had fed when 2–9 days old on radioactive phosphorus as phosphoric acid at about 20 microcuries per 1,000 insects, were released in the centre of a study area in Oregon after sunset on 12th August 1951. The phosphoric acid was added to about 12–15 ml. water containing sugar, and samples of the flies showed radioactivity ranging from 200 to 8,000 counts per minute at the time of release. Traps baited with decomposed liver and fermented molasses were set up, 24 within 4 miles and 16 at a distance of 8–16·5 miles in various directions from the point of release. On the second day after the flies were released, two traps were moved to 20 miles, one to 24 miles and one to 28 miles south or south-east of the release point. Prevailing winds were from the north-west and the mean daily temperature was 66·4°F. with a mean maximum and minimum of 84 and 49°F., respectively.

Marked adults of *P. regina* were recovered from all but two of the traps. The largest number from a single trap was 347 from the nearest one, which was half-a-mile from the point of release, but 216, four, 22 and one were taken 3·5 miles east, 13 miles north-west, 15·5 miles north-east and 28 miles south-east, respectively. None was taken more than 4 miles away within 24 hours, but

some were found in all but five of the inner traps and in all but seven of the more distant ones after 48 hours. By the 13th day, 26 had reached the traps 17–28 miles out. Six were taken at the last collection on 6th September. Of the flies taken in the distant traps, 45 per cent. were females. The traps in the outer area caught an average of 10 *P. regina* each.

M. domestica dispersed much less freely. Marked individuals were taken in 15 of the 24 traps in the inner area 24 and 48 hours after release, but thereafter catches declined, and no flies were taken after 12 days. The traps half-a-mile and one mile from the point of release caught 1,216 and 110, respectively. No other caught more than 30. Only six individuals were recovered at a distance of eight miles or more from the point of release, the furthest 20 miles away and all to the south. Of the total recovered, 80 per cent. were females. Of the *Lucilia* released, 25 were recovered, all in traps in the inner circle.

JONES (B. M.). **A Method for studying the Distribution and Bionomics of Trombiculid Mites (Acarina : Trombidiidae).**—*Parasitology* **40** no. 1–2 pp. 1–13, 7 figs., 35 refs. London, 1950.

The medical importance of larvae of Trombiculid mites is briefly reviewed, and methods that have been used for assessing their distribution in the Far East and for studying *Trombicula autumnalis* (Shaw) in Britain are discussed. A description is then given of a simple light-trap and the way in which it was used to make an ecological study of larvae of *T. autumnalis*. It consists of a sheet of light-proof paper 2 ft. square with a celluloid window attached to an opening $2\frac{1}{2}$ ins. square in the centre. The sheet is laid on the ground and the edges are pegged down, and when mites are seen to be numerous on the underside of the window or when a given time has elapsed, the sheet is taken up and the mites collected. To reach the window, the mites crawled up only the vegetation in the light field. In addition to providing a new approach to the problem of surveying an area for Trombiculid infestation, the method is of value in providing abundant material for laboratory investigations. For an ecological survey, 100–150 traps to the acre is a convenient number.

The results of a detailed survey made in August–October 1947 in a garden in Edinburgh are given to illustrate the use of the method in studying the distribution and bionomics of Trombiculids. Larvae of *T. autumnalis* were found in 17 of 47 sites examined. The positive sites were confined to two areas, a shady moist weed-covered path and a wood. In the wood, the mites were closely concentrated in pockets, but in the path they were more dispersed. Laboratory results and field data strongly implied that humidity is the limiting factor in distribution. The relative humidity of the positive sites was consistently above 78 per cent. Catches were greatest in the afternoon when the soil temperature was highest. The free-living larvae disappeared in October, and nymphs were found in the soil in September. These facts, together with the results of laboratory breeding experiments at room temperatures, which showed that it was normal for nymphs to appear in October, indicate that the winter is passed in the nymphal and adult stages, and the occurrence of larvae on hosts in winter [*R.A.E.*, B **23** 220] appears to be incidental to the true life-cycle. In a survey of the mites as causes of irritation in the Edinburgh district in 1947, about 50 per cent. of reported cases were associated with fruit bushes in gardens. However, the present work showed that the mites are not associated with fruit bushes if the physical conditions of the soil are unfavourable. A possible explanation of the frequent association of fruit bushes with mite-irritation is suggested. The gregarious habit of clustering seems to be primarily due to a tactile response.

Milne (A.). **The Ecology of the Sheep Tick, *Ixodes ricinus* L. Microhabitat Economy of the Adult Tick.**—*Parasitology* **40** no. 1–2 pp. 14–34, 1 graph, 14 refs. London, 1950.

For the studies that form the subject of this paper, adults of *Ixodes ricinus* (L.) were laid down for observation in sites on two Northumberland farms, representing the rough bent-grass, bracken, heather and fine-grass types of grazing [*cf. R.A.E.*, B **32** 232; **37** 193]. Unfed females and males were studied in deep vegetation layers and engorged females in different types of vegetation layer. When the turves on which the ticks had been laid down were lifted (active ticks having previously been collected from them), practically all inactive unfed adults were in the under-lying mat, generally in the upper part of it. This applied both in summer and winter. Even in the season of activity, only a small fraction of the adult ground population is active at a given time. When a tick is active, its movement is almost entirely vertical. Observations on nine marked individuals over a period of three months showed that random undirected movements resulted in an average change of 2 ins. in horizontal position with a range of 0–8 ins., but there is apparently no ruling urge to move horizontally. The unfed tick comes to the vegetation tips to await a host for only a limited time during the three-month season of activity [*cf.* **39** 95]. Commonly this amounts to about five periods of 4–5 days each if no host is forthcoming. Between the periods of activity, it returns to the upper mat. If it stayed constantly at the tips, its survival time would be much shorter than normal. Adults emerge in autumn from nymphs engorged in spring, but remain inactive for some time. The experiments indicated that about half may perish within 100 days of emergence. Survivors become active in March–June. Effective life ends when the tick, if still unfed, stops coming to the vegetation tips, the only position from which a host can normally be reached. An experiment with over 400 individuals indicated that the effective life of the unfed adult deprived of a host is less than one year after emergence, so that adults not finding a host in one season of activity die, without reproducing, before the next.

The ruling urge of engorged females when dropped on the ground was to proceed vertically downwards into the cover of the vegetation. Horizontal movement was random and confined to the minimum necessary for finding a way down through the mass of stems. Engorged females were unable to find cover on a short dense sward and died of desiccation without ovipositing. On a short sward intermingled with clumps of long bent-grass, they sometimes attained cover at a distance of about 3 ins. from their arrival point but could not reach it if it was further away. In a deep vegetation layer of rough bent-grass, the females sought the cover of the upper mat and, if they escaped predators, completed oviposition after about two months. The proportion of females that managed to oviposit was larger among those that engorged late in the spring season of activity. Mortality before oviposition through the activity of predators was high. Experiments that are described in some detail showed that the common shrew was the chief predator and indicated that birds probably play some part. There did not appear to be any arthropod predators.

The relationship between temperatures and humidities at the vegetation tips and at different lower levels in a deep vegetation layer were studied in an area of rough bent-grass. Temperatures were always very near those of the macroclimate at the vegetation tips and were in general lower in summer and higher in winter at the deeper levels. Relative humidity at the vegetation tips varied from 40 to 100 per cent. in 1942. It returned to 100 per cent. each night, was less than 90 per cent. for more than half and usually for three-quarters of the 24 hours during the season of activity and was less than 80 per cent. for just under half the day. In the upper mat, it remained constantly at, or very

near, 100 per cent. throughout the year. The chief facts concerning the physiology of the tick as related to its microhabitat are reviewed. Its water relations and behaviour [**36** 211 ; **39** 94] suggest that it will be most successful in an environment providing ready access to a constant relative humidity of 100 per cent. In the deep layer of a rough hill or moorland pasture, the ticks can easily make their way down into the upper mat where such humidity conditions exist, and it is in such rough pasture that population density indicates that the species is most successful.

Milne (A.). **The Ecology of the Sheep Tick, *Ixodes ricinus* L. Spatial Distribution.**—*Parasitology* **40** no. 1–2 pp. 35–45, 31 refs. London, 1950.

The following is based on the author's summary. The term spatial distribution is used to denote distribution of density (including zero density) over the land surface at a given time. Data on factors limiting *Ixodes ricinus* (L.) are summarised from the literature, and a theory of its spatial distribution in Britain is put forward. The tick passes practically the whole of its three years of life on the ground, spending only three weeks on hosts. Considerable vegetational cover is needed for survival on the ground, the more important limiting factors in inadequate cover being apparently humidity (conditioned by temperature) in summer, perhaps temperature alone in winter, and the activity of predators [*cf.* preceding abstract]. A host is necessary for mating as well as to provide food. A tick's chances of reaching a host are proportional to the number of hosts on the ground, and in practice to the number of sheep, since these are by far the most important hosts [*R.A.E.*, B **40** 77]. Even where sheep stocking is at its maximum, enormous numbers of ticks fail to find a host. Spatial distribution can be explained in terms of interplay between the amount of ground-cover and of number of hosts available, with cover as the main factor. Thus, poor cover keeps the heavily stocked lowland pastures free of permanent tick populations even when opportunity of colonisation is offered. On the hills and moorlands with their deep vegetation layers, the ticks are in general more numerous where adequate cover is well distributed and hosts are numerous, though there are some pastures where, despite ample cover and hosts, ticks are absent or comparatively scarce. This is probably because of lack of opportunity for colonisation or colonisation so recent that population has not reached equilibrium with the environment. The question of colonisation is discussed at some length. Spread is now comparatively slow and slight and is effected mainly by flocks of sheep. Both tick population densities and infested areas have probably increased considerably since intensive hill and moorland grazing with farm stock began some centuries ago.

Philip (C. B.) & Fuller (H. S.). **The Harvest Mites ("Akidani") of Japan and the Far East and their Relationship to the *autumnalis* Group of Trombiculid Mites.**—*Parasitology* **40** no. 1–2 pp. 50–57, 1 pl., 3 figs., 17 refs. London, 1950.

Larvae of *Trombicula tamiyai*, sp. n., from Japan and *T. fujigmo*, sp. n., from northern Burma are described and figured, the characters of *T. japonica* Tanaka et al. are given for comparison, and the relationship of these three species to the European *T. autumnalis* (Shaw) is discussed. *T. tamiyai*, unnamed or referred to *T. autumnalis*, has previously been illustrated and discussed by some Japanese authors with *T. japonica* under the term "Japanese harvest mites." Reared nymphs and adults of the Japanese mites are reported by Japanese workers to be unusually elongate, and from their figures, the nymphs appear to resemble those of *T. autumnalis*, the adult of which is also elongate. Specific larval characters of these and 15 apparently closely related species of *Trombicula* are given in a table and discussed.

Mer (G. G.) & Davidovici (S.). **A Method for estimating the toxic Effect of Contact Insecticides on Mosquitoes and House-flies.**—*Parasitology* **40** no. 1–2 pp. 87–92. London, 1950.

Individual females of *Anopheles maculipennis* var. *sacharovi* Favr and individual house-flies (*Musca domestica* var. *vicina* Macq.) were induced to remain in contact for a definite time with a plate that had been sprayed with DDT solution and dried, and their survival times under standard conditions of humidity and temperature were recorded. The average length of life of groups was calculated and compared with that of controls. The data were analysed statistically by R. Bachi. Solutions containing various concentrations of DDT were applied at 2 mg. per sq. cm., and even distribution was ensured by spraying the plates on a rotating drum. The mosquitos were exposed for 2·5, 5 or 10 minutes in a rotating glass cylinder with the sprayed plate covering the open end and providing the only non-rotating surface on which they could alight. The flies were exposed for 90 seconds in a glass tunnel of triangular cross-section closed at both ends, the whole inner surface of which had been sprayed before assembly. By altering the inclination of the tunnel, the flies were induced to walk backwards and forwards along it. Ten unfed and non-gravid females of *A. m. sacharovi* or ten containing blood and eggs were tested on each glass plate and ten house-flies in each tunnel. After the test, they were kept in clean cages at 24–27°F. [75·2–80·6°F.] and 75–85 per cent. relative humidity. The number of mosquitos knocked down and unable to rise when the cage was shaken was recorded every three hours for the first 12 hours and subsequently every 12 hours. The number of flies knocked down was recorded every half hour during the first three hours and every three hours thereafter. No recovery of insects knocked down was recorded, and knockdown is taken as a criterion of death.

Individual mosquitos of the same group differed in time of survival. The average times of survival in different random groups of ten unfed females that had been in contact with identically treated surfaces depended on the duration of contact and were sufficiently constant to be comparable, provided the duration of contact was 5 or 10 minutes. With contact for 2·5 minutes, toxic effect was slight and variation considerable. The death-rate was always highest during the first three hours after contact. Average life after contact was largely independent of the DDT content (1–5 per cent.) of the solution, with a contact time of 5 minutes. Females with blood and eggs seemed less susceptible to the toxic action of DDT than the unfed ones. The house-flies, like the mosquitos, showed individual differences in resistance, but the survival times in various groups after contact for 90 seconds were constant enough to be comparable and within certain limits were independent of the DDT content (2·5–5 per cent.) of the solution. No differences were observed between groups of males and females 24 hours old, but older females with eggs seemed to be less susceptible.

Richards (W. S.). **The Variation of the British Harvest Mite (Trombiculidae, Acarina).**—*Parasitology* **40** no. 1–2 pp. 105–117, 23 figs., 4 refs. London, 1950.

A key is given distinguishing five main types of Trombiculid larvae found in Great Britain, and the morphological differences are discussed at some length. As these appear not to be genetically determined but to be connected with environment during larval development and because of the lack of points of distinction among nymphs and adults, the author is of the opinion that all the forms are larvae of *Trombicula autumnalis* (Shaw), the only known British

species. However, this hypothesis cannot be disproved or confirmed until larvae of known ancestry can be reared under controlled conditions.

RICHARDS (W. S.). **The Distribution and Biology of the Harvest Mite in Great Britain (Trombiculidae, Acarina).**—*Parasitology* **40** no. 1–2 pp. 118–126, 3 figs., 7 refs. London, 1950.

Previous work on the distribution in Britain and behaviour of *Trombicula autumnalis* (Shaw) is briefly reviewed, and methods of sampling populations are discussed. The numbers of free unengorged larvae per square yard can be estimated on dry soil or short grass by means of light-traps [*R.A.E.*, B **36** 208] and in longer vegetation by the use of caged guineapigs. The infestation observed on the ears of wild rabbits gives a rough index of the population present in a given area during a limited space of time. Engorged larvae can be collected from their hosts by using a modified light-trap [*cf. loc. cit.*]. Adults can be extracted from light, friable soils by flotation in water and from any type of soil by the Salt-Hollick soil-sampling machine, which first removes organic matter from the soil by floating it off in magnesium-sulphate solution with a specific gravity of 1·18 and then separates the arthropods from the vegetation by xylene, which wets arthropod cuticles.

A survey in 1946 indicated that *T. autumnalis* occurs throughout the British Isles. It seems possible that neither climate nor the geological origin of the soil affects its abundance. It is, however, less numerous on heavy clays than other soils. Larvae are most abundant in late summer and autumn. Adults remain constant in numbers throughout the year. The larvae appear to infest most warm-blooded vertebrates. They do not attack at night. Nymphs have been observed sucking the contents of nymphophanes. Adults have been found at a depth of 3 ft. They appear to come nearer the surface in warm, moist weather, but are driven down by drought, heavy rain and ground frost.

JONES (T. W. T.). **Anopheline Larvae as intermediate Hosts for larval Trematodes.**—*Parasitology* **40** no. 1–2 pp. 144–148, 2 figs., 12 refs. London, 1950.

During an extensive survey of Anopheline larvae in a locality of south-eastern Ceylon, 40 per cent. of *Anopheles culicifacies* Giles, 68 per cent. of *A. aconitus* Dön., and 12 per cent. of *A. annularis* Wulp were found to contain cercariae. No sporocysts or rediae were found, and no Anopheline larvae of other species harboured the parasites. Most of the cercariae were in the body cavity of the thorax. Sometimes there were 11–12 in one larva, but usually 4–5. A few larvae had one or two cercariae in the second or third abdominal segment. The structure and anatomy of the cercaria is described, and nomenclature, classification and possible life-history are discussed.

CRAGG (J. B.). **The Reactions of *Lucilia sericata* (Mg.) to various Substances placed on Sheep.**—*Parasitology* **40** no. 1–2 pp. 179–186, 11 refs. London, 1950.

The work described is the continuation of experiments [*R.A.E.*, B **33** 167] in which it was shown that ethyl mercaptan in conjunction with ammonium carbonate attracts *Lucilia sericata* (Mg.) when pads impregnated with them are placed on living sheep. It was suggested that sulphur compounds of that type might arise under natural conditions from the breakdown of cystine in fleece keratin. The reactions, under field conditions, of *L. sericata* to various

substances placed on sheep were studied in 1944 in North Wales and in 1947 in northern England. The methods used are described.

Solid cystine or a solution of cysteine hydrochloride failed to attract the flies or induce oviposition when placed in the living fleece. Several organic sulphur compounds such as might arise from the breakdown of cystine all showed some attraction, that exercised by ethyl mercaptan and dimethyl disulphide being the greatest. However, none induced oviposition alone, though all the liquid ones did so in the presence of ammonium carbonate at a concentration that was too weak to attract flies or induce oviposition when used alone. Tests in which the flies were induced to oviposit by ammonium carbonate or bicarbonate but not by ammonium hydroxide, though they were attracted by all three compounds, indicated that ammonia is an attractant by itself, but that conjunction with carbon dioxide (provided by the carbonate or bicarbonate) is necessary for oviposition. The importance of the combination of carbon dioxide and ammonia as an oviposition stimulus was confirmed by tests in which carbon dioxide did not attract the flies or induce oviposition when used alone, and did not induce oviposition when used with organic sulphur compounds that acted as attractants, but induced oviposition in the presence of ammonium hydroxide at a concentration that attracted flies, or of ammonium hydroxide at a lower concentration together with ethyl mercaptan as the attractant. Hydrogen sulphide was detected as a constituent of the fleece atmosphere of certain sheep. Though it is not attractive when used alone on sheep, it increased the attractiveness of organic sulphur compounds. Comparative tests of indole and ethyl mercaptan in the presence of ammonium carbonate showed marked variation in their relative powers to induce oviposition.

The results emphasise that a distinction can be drawn between stimuli that attract *L. sericata* to sheep and those that induce oviposition. Some of the stimulant materials may be produced in nature from the breakdown of fleece keratin or by the bacterial decomposition of sweat and similar products in the fleece.

Cragg (J. B.) & Thurston (B. A.). **The Reactions of Blowflies to organic Sulphur Compounds and other Materials used in Traps.**—*Parasitology* **40** no. 1–2 pp. 187–194, 8 refs. London, 1950.

An account is given of the reactions of blowflies to seven organic sulphur compounds likely to be produced in the breakdown of cystine [*cf.* preceding abstract] tested as attractants in traps under field conditions in England and Wales. The flies trapped included *Lucilia caesar* (L.) and *L. illustris* (Mg.), but as females of these two species could not be differentiated, both are referred to as *L. caesar* in the trapping records. None of the sulphur compounds showed appreciable powers of attraction when used alone, but ethyl mercaptan and dimethyl disulphide were powerful in attracting females of *L. caesar* and *L. sericata* (Mg.) when mixed with hydrogen sulphide or carbon dioxide. Detailed trials showed that high concentrations of both constituents gave the highest catches, and results were better when the constituents were mixed than when they were in separate containers. On the basis of the results, 10 ml. 0·2 per cent. ethyl mercaptan mixed with 10 ml. freshly prepared saturated hydrogen-sulphide solution was generally used as a standard. It was better than ammonium carbonate, indole and hydrogen sulphide [*R.A.E.*, B **33** 167], and overcame many of the disadvantages of meat baits. Sodium carbonate, sodium bicarbonate, ammonium hydroxide, ammonium carbonate and indole, at various concentrations, did not activate the organic compounds, nor did they increase the activity of the ethyl mercaptan and hydrogen sulphide preparation when added to it. Oviposition was induced rarely and only in the

presence of indole. Batches of flies reared from the egg masses comprised seven of *L. illustris*, four of *L. sericata* and one of the two species mixed. All batches bred at the same time from sheep were *L. sericata*. *L. caesar*, which usually outnumbered *L. sericata* in traps on the ground, also responded to attractants put 2 ft. from the ground. Height alone, therefore, is not responsible for the failure of *L. caesar* to respond to the attractants when they are put on sheep. Possible causes are discussed. Response of some species of blowflies to the chemical attractants was linked with climatic conditions. Comparative catches with meat baits at a centre in North Wales showed that in August the chemical attractants were selecting *Lucilia* from a mixed population in which *Calliphora* spp. were at times quite numerous, but in October, *C. vomitoria* (L.) and *C. erythrocephala* (Mg.) particularly the former, responded to them to almost the same extent as they did to meat. Trapping experiments in exposed positions on the Pennines showed that *L. sericata* occurs there in large numbers.

WATERHOUSE (D. F.) & PARAMONOV (S. J.). **The Status of the two Species of *Lucilia* (Diptera, Calliphoridae) attacking Sheep in Australia.**—*Aust. J. sci. Res.* (B) **3** no. 3 pp. 310–336, 1 pl., 13 figs., 49 refs. Melbourne, 1950.

Since about 1932, much evidence has accumulated that the most important sheep blowfly in Australia is *Lucilia cuprina* (Wied.) [*R.A.E.*, B **20** 163; **26** 81] and that *L. sericata* (Mg.) from which it differs in distribution, habits and morphology, is unimportant there. For many years, the same was thought to be true in South Africa, but Ullyett reported in 1945 that the two would mate in the laboratory, with results already noticed [**35** 100], and concluded that they should be considered forms of one species. The extension of this theory to cover the position in Australia was felt by Australian workers to be unsound, and an examination of the status of the two forms in Australia and elsewhere, from which it is concluded that they clearly represent distinct species, is the subject of this paper.

Previously unrecognised characters differentiating the two species in the adult and larval stages are set out in detail, and the features by which they were previously distinguished, not all of which are valid, are discussed. Lists of their synonyms, and a note on the status of the subgenus *Phaenicia*, to which both belong, are also given. It is concluded that *L. pallescens* Shann. [**12** 75] is a synonym of *L. cuprina* and that this species is represented by two subspecies readily distinguishable by colour, of which *L. c. cuprina* occurs over a very large area of Asia, the Pacific, and North and South America and *L. c. dorsalis* R.-D. in Africa, India and Australia. Neither is known from Europe or New Zealand. The synonyms of *L. sericata* include the species A and species B of Miller [**28** 139]. In general, *L. cuprina* appears to be restricted to the warmer sub-equatorial regions and to tolerate semi-arid conditions better than *L. sericata*, which has been recorded from all temperate countries and is typically found where humidity is high.

L. cuprina occurs in all the mainland states of Australia but has not been recorded from Tasmania. It is most abundant in the sub-tropical and semi-arid regions of northern New South Wales and southern Queensland, particularly during spring and autumn, but is plentiful also on the cooler tablelands of southern New South Wales. One of the factors affecting its distribution in Australia appears to be the availability of suitable sheep on which to breed [**37** 45–46]. *L. sericata* has been recorded from all Australian states, including Tasmania, but is usually uncommon except in limited, closely settled areas, and its distribution has no relation to that of sheep. *L. cuprina* occurs in the open savannah woodland characteristic of much sheep-grazing country around

Canberra, and *L. sericata* occurs commonly in Canberra gardens. The preferences of the two species for these habitats were therefore examined by counting the numbers of each caught in baited traps exposed simultaneously in a garden, in open country, and in intermediate situations. In the first experiment, the numbers of *L. cuprina* and (in brackets) *L. sericata* caught in three days were 7 (1,025) in a trap exposed in a well-watered garden with luxuriant vegetation, 22 (173) in a trap in an unwatered orchard on the outskirts of Canberra and 74 (16), 170 (24) and 98 (6) in three traps near sheep in open grazing country. In the second experiment, *L. cuprina* formed about 1 per cent. of the catch in the garden, about 40 per cent. in grassland within plantation 150 yards away and in open grassland 390, 610 and 760 yards away, and 97 per cent. five miles from the city on a sheep-grazing property. The general trend was followed closely during each of three trapping periods. The numbers of *L. cuprina* caught in the various traps were similar, the variation in percentage being caused by the numbers of *L. sericata*. The latter frequents urban districts and is common in garbage.

M. J. Mackerras succeeded in crossing *L. cuprina* and *L. sericata* [**21** 247] and found that all offspring resembled *L. cuprina*. Examination of F_1 and F_2 flies obtained in her work confirmed that all had the appearance of typical *L. cuprina*. In an endeavour to check these results, pupae from pure cultures of *L. cuprina* and *L. sericata* were put in individual tubes and the adults that emerged were sexed and caged for cross-breeding under conditions favourable to breeding by both species. Eggs were laid in a number of experiments but failed to hatch. The amount of oviposition was no greater than would be expected from unfertilised females. In the only successful experiment, ten egg masses were laid in a cage containing 25 males of *L. sericata* and 50 females of *L. cuprina*, and larvae hatched from seven, finally giving 151 male and 139 female F_1 hybrids. It is possible that only one of the 50 females laid fertile eggs. All the parents used in this experiment (examined for all characters except male genitalia) were typical of the species to which they belonged. About 80 per cent. of the hybrids were intermediates but were generally closer to *L. cuprina* than to *L. sericata*, about 10 per cent. were indistinguishable from *L. cuprina* and the remaining 10 per cent. distinguishable only with difficulty. None could be confused with *L. sericata*. F_2 progeny were obtained from three of the seven batches of F_1 hybrids. All of 148 F_2 males and 117 F_2 females examined from three separate ovipositions of one of these three F_1 batches were indistinguishable from typical *L. cuprina*, but of 25 F_2 males and 31 F_2 females derived from the other two batches of F_1 hybrids that laid eggs, one male and six females were indistinguishable from *L. cuprina*, three males and one female were indistinguishable from *L. sericata* and the remainder were intermediates, though often differing from one or other species only by a single character. It thus appears that successful mating between *L. cuprina* and *L. sericata* is difficult to obtain, that the F_1 hybrids are intermediates or resemble *L. cuprina*, and that the picture in the F_2 generation is very complicated. Twelve males of *L. cuprina* and nine females of *L. sericata*, which had been used as parents in Ullyett's crossing experiments, and seven male and six female F_1 hybrids that he obtained were also examined. The male parents were typical except in one detail, and six of the female parents were typical of *L. sericata* ; the wings of the other three were crumpled and the ptilinum had not been properly retracted. The hybrids were typical of *L. cuprina* in all the characters except one, which was typical of *L. sericata*, and all must therefore be regarded as intermediates. The abdominal coloration of the hybrids was somewhat different from that of their parents, possibly because of different drying conditions. No support was found for Ullyett's contention that abdominal coloration is useful for distinguishing *L. cuprina* from *L. sericata*.

Data on the importance as pests of sheep of *L. sericata* and the two subspecies of *L. cuprina* are further reviewed from the literature. *L. sericata* has been recorded from sheep in South Africa [**33** 6] and the United States [*cf.* **31** 151], but is of importance only in Britain [**22** 132 ; **24** 41 ; **31** 150] and New Zealand [**28** 140]. It does not attack sheep at all commonly in western Europe [**38** 124] or in the Ukraine or northern Caucasus [**26** 46]. *L. c. cuprina* is apparently of no importance, though it occurs in sheep-raising countries in America, and sheep of a probably susceptible breed are available in the United States. *L. c. dorsalis* is far the most important sheep blowfly of Australia [**26** 81 ; **33** 181] and South Africa [**33** 6, 27] and has been recorded from sheep in Kenya ; Australian experiments [**33** 181] indicate that it oviposits more readily on sheep than does *L. sericata*.

HENNIG (W.). **Die Larvenformen der Dipteren. Eine Übersicht über die bisher bekannten Jugendstadien der zweiflügeligen Insekten. 3. Teil.** [Larval Forms in Diptera. A Review of the known immature Stages of Dipterous Insects. Part 3.]—vii+628 pp., 21 pls., 338 figs., 100 pp. refs. Berlin, Akademie-Verlag, 1952. Price *DM.* 65.

The third and largest part of this work [*cf. R.A.E.*, B **38** 106] is devoted to the Brachycera, which are treated in the same way as were the Nematocera. The bibliography covers the whole of the Diptera and an index to the genera in all three parts is appended.

EADS (R. B.), HENDERSON (H. E.), MCGREGOR (T.) & IRONS (J. V.). **Relapsing Fever in Texas : Distribution of Laboratory confirmed Cases and the Arthropod Reservoirs.**—*Amer. J. trop. Med.* **30** no. 1 pp. 73–76, 2 maps, 8 refs. Baltimore, Md., 1950.

The following is virtually the authors' summary. In Texas, 100 cases of relapsing fever were confirmed by demonstration of spirochaetes in thick films of the patient's blood, or in blood films of rodents inoculated with a small amount of the patient's blood, during the period June 1942 to May 1949. The cases occurred chiefly in the central part of the State, with scattered ones in all but extreme East Texas. During the same period, examples of *Ornithodoros turicata* (Dugès) were taken in 44 counties, representing all sections of the State except East Texas. In all but eight of the counties, pools of the ticks were shown to contain individuals harbouring spirochaetes.

PERRY (W. J.). **The Mosquitoes and Mosquito-borne Diseases on New Caledonia, an historic Account : 1885-1946.**—*Amer. J. trop. Med.* **30** no. 1 pp. 103–114, 5 figs., 20 refs. Baltimore, Md., 1950.

The following is substantially the author's summary. Of the three important mosquito-borne diseases occurring in the Pacific islands, dengue was of paramount importance in New Caledonia during military occupation by United States forces in 1942–46. The disease has been known there since 1885, and the virus appears to have been introduced by surface vessels from endemic areas such as Indo-China. Epidemics have been reported in the literature for several years following the initial outbreak in 1885. The chief vector on the island is *Aëdes aegypti* (L.). With the institution of control measures directed against it in 1942, the incidence of dengue dropped dramatically over a period of three years [*cf. R.A.E.*, B **39** 174]. By 1946, only an occasional case was reported in the civilian and military population of Noumea.

Malaria was reported only as secondary cases in American combat troops undergoing " demalarialisation " in New Caledonia and in the indentured

Javanese and Tonkinese labourers employed in the nickel mines of the island. They had acquired their primary infections in other areas. Mosquitoes of the genus *Anopheles* were not found, and the consensus of opinion among entomologists is that New Caledonia remained free of Anophelines up to the cessation of military occupation in 1946.

Filaria (*Wuchereria*) *bancrofti* was found in blood film studies. *Culex pipiens* var. *fatigans* Wied. (*quinquefasciatus*, auct.) is believed to be the most important vector. Larval surveys showed the presence of 13 species of mosquitos, belonging to the genera *Aëdes*, *Culex*, *Mansonia* and *Tripteroides*.

MARYON (M.), LEE (P.) & SHUTE (P. G.). **Experimental Hybridization of *Anopheles maculipennis* var. *atroparvus* Meigen** [*sic*] **and *Anopheles quadrimaculatus* Say.**—*Proc. R. ent. Soc. Lond.* (A) **26** pt. 7–9 pp. 109–111. London, 1951.

Hybridisation experiments were made with *Anopheles maculipennis* var. *atroparvus* van Thiel bred in the laboratory from a strain obtained in south-eastern England in 1933 and *A. quadrimaculatus* Say from the United States. Of 51 *atroparvus* females caged with *quadrimaculatus* males, 17 developed ripe ovaries and laid one or more batches of eggs. The spermathecae of all but one of the 17 were positive on dissection. Healthy and vigorous larvae hatched from 17 of the 24 egg batches within three days of oviposition, and 115 reached the pupal stage 11–16 days after hatching. From the 89 pupae that survived, three females emerged normally and lived 3–4 days but refused to feed, 47 emerged with great difficulty and died within 24 hours, and the remaining 39 drowned while emerging. No male adult was seen. Of 70 *quadrimaculatus* females caged with *atroparvus* males, 19 developed ripe ovaries and laid 2–6 batches of eggs. Only two of these had negative spermathecae. Of the 60 egg batches, 25 failed to hatch. All eggs that hatched did so within three days. The larvae did not appear healthy, and survival rate was low, but 77 reached the pupal stage 11–21 days after hatching. From the 56 pupae that survived, 19 females emerged normally ; the others either emerged with difficulty and lived only a few hours, were unable to disentangle themselves from their pupal cases, or were drowned. No male was seen. All of the 19 females that emerged normally fed on dextrose solution, 11 also took human blood and two of these fed on blood four times. All refused to mate with males of either parent strain.

All the eggs of both crosses appeared normal and showed the characters of the female parent.

SUNDARARAMAN (S.). **Biometrical Studies on Intergradation in the Genitalia of certain Populations of *Culex pipiens* and *Culex quinquefasciatus* in the United States.**—*Amer. J. Hyg.* **50** no. 3 pp. 307–314, 3 figs., 10 refs. Lancaster, Pa., 1949.

In the course of a study of mosquitos of the complex of *Culex pipiens* L. in the United States [*cf. R.A.E.*, B **40** 64, 67], measurements were made of the male genitalia of *pipiens* from Maryland, *fatigans* Wied.(*quinquefasciatus*, auct.) from Texas and Georgia, a colony with intermediate characters probably originating from Alabama, F_1 and F_2 laboratory hybrids from reciprocal crosses of Maryland *pipiens* and Texas *fatigans*, and finally certain specimens caught in nature in nine other widely separated States. The findings indicated that the DV/D ratio, in which D is the distance between the tips of the dorsal arms of the phallosome and DV the distance between the tips of the dorsal and ventral arms (average of the two measurements), should be adopted as a means of identifying these mosquitos. The laboratory hybrids and the

Alabama strain had intermediate characters. The males caught in nature furnished additional evidence that the relative positions of the phallosome arms will separate the northern and southern populations but that intermediate forms occur that cannot be determined with certainty. Since hybridisation between the northern and southern types appears to occur in nature as well as in the laboratory, it is believed that the northern *pipiens* and the southern *fatigans* are subspecies of *C. pipiens*.

TRAUB (R.). **Observations on Tsutsugamushi Disease (Scrub Typhus) in Assam and Burma. The Mite, *Trombicula deliensis* Walch, and its Relation to Scrub Typhus in Assam.**—*Amer. J. Hyg.* **50** no. 3 pp. 361–370, 8 refs. Lancaster, Pa., 1949.

A preliminary report on observations on tsutsugamushi disease in Assam and Burma by a field party of the United States Typhus Commission has already been noticed [*R.A.E.*, B **37** 91, 94], as have data on the recovery of strains of *Rickettsia orientalis* [**38** 192]. Additional observations and data on *Trombicula deliensis* Walch and its relation to the disease in Assam are given in this paper, and the following is based on the author's summary of it. Unless otherwise specified, all statements refer only to the Ledo region of Assam and to Trombiculid mites and tissues from *Rattus flavipectus yunnanensis*. Nine areas near Ledo were found to vary with respect to the incidence of tsutsugamushi disease on the basis of case rates in April–June 1945 and isolation of strains of rickettsiae from Trombiculids and tissues. *T. deliensis* formed 13–96 per cent. of Trombiculids in samples from these areas. It was most prevalent and constituted 60, 74 and 96 per cent. of Trombiculids from the three areas where the incidence of the disease was greatest, and was least abundant in the areas reporting no cases. Samples (10–25 mites) consisting entirely of *T. deliensis* were found much more frequently in hyperinfective areas than in less infective ones.

T. deliensis was reported in every batch of mites from which strains of rickettsiae were isolated and formed 88 per cent. of the mites examined from 36 such batches. The percentage in samples of batches from which strains were isolated was usually much higher than the overall percentage for the area. In the area where the danger of infection was considered to be highest, 12 strains of rickettsiae were isolated in 30 attempts and over 99·5 per cent. of the mites sampled from the batches from which isolations were made were *T. deliensis*. The percentage of this species in samples of negative batches from the same area was almost as high.

Over 99 per cent. of the rats caught in the Ledo region were *R. f. yunnanensis*. It was extremely abundant and when caught frequently had 250–300 Trombiculids attached to the ears. Eight strains of rickettsiae were isolated from its tissues in addition to 40 from its mites. It is considered on these accounts to play a very important part in the epidemiology of tsutsugamushi disease in the Ledo region. Shrews (mainly *Suncus*) may be involved to some extent. They serve as hosts to *T. deliensis* and two strains were isolated from their mites. They were often more abundant in tents and living quarters than were rats. Data are presented indicating that *T. deliensis* was more abundant on various species of rats taken in grassy terrain and other scrub growth along the roadside in North Burma than on those in contiguous primary jungle. Seasonal changes in the numbers and species of mites are noted for Assam and North Burma. *T. deliensis* was much more prevalent in the wet season than in the dry season, although it was found throughout the year. Certain genera and species were taken only during the dry period, others only during the rains.

Wharton (G. W.) & others. **The Terminology and Classification of Trombiculid Mites (Acarina : Trombiculidae).**—*J. Parasit.* **37** no. 1 pp. 13–31, 8 figs., 45 refs. Lancaster, Pa., 1951.

Suggested characters for use in describing larvae and adults of Trombiculid mites are given, together with glossaries of the relevant terms, and keys to the subfamilies, genera and subgenera on the basis of larval characters and to a few genera on the basis of adult characters. As the type of *Trombicula, T. minor* Berl., is known only from the adult [*cf. R.A.E.*, B **35** 36], the subdivisions of this large genus, based on larval characters, are considered as subgenera. They comprise *Fonsecia, Trombiculindus, Eutrombicula* [*cf.* **39** 166], *Leptotrombidium, Blankaartia* and *Neotrombicula.*

Fox (I.). **Relative and seasonal Abundance of the common Rat Ectoparasites of San Juan, Puerto Rico.**—*J. Parasit.* **37** no. 1 pp. 85–95, 6 figs., 16 refs. Lancaster, Pa., 1951.

The following is based on the author's summary. To obtain knowledge on the relative and seasonal abundance of the six common ectoparasites of rats in the municipality of San Juan, Porto Rico, separate surveys were made of the poorer districts of the residential section of the city known as Santurce and of the restaurants in the business district of San Juan proper. Examination of 387 rats (353 of which were *Rattus rattus*) over a period of one year in San Juan proper showed the order of abundance of the six ectoparasites to be *Xenopsylla cheopis* (Roths.), *Ornithodoros puertoricensis* Fox [*cf. R.A.E.*, B **39** 35], *Bdellonyssus bacoti* (Hirst), *Laelaps nuttalli* Hirst, *Polyplax spinulosa* (Burm.) and *Echidnophaga gallinacea* (Westw.). In Santurce, observations were made over a period of about three years on a total of 938 rats (of which 809 were *R. norvegicus*). They were consistent from year to year as regards *L. nuttalli*, which both in numbers and percentage of rats infested was the most abundant species. *X. cheopis* was consistently fourth in numbers, but was second in percentage of rats infested in 1946 and 1947 and third in 1948. *O. puertoricensis* was third in numbers in 1946 and second in 1947 and 1948 and was third in percentage of rats infested in 1946 and 1947 and second in 1948.

The monthly average number of individuals per rat and the monthly percentage of rats infested were calculated for the species that were abundant enough, in an effort to ascertain whether abundance varied with the season of the year. This was done because the reported cases of typhus in man in Porto Rico are almost always more numerous in May–August than in the rest of the year. As regards San Juan proper, variation in abundance of ectoparasites could not be related to season, but this survey covered only one year. The Santurce survey continued for three years, and hence it was possible to obtain more complete data on seasonal abundance and also to compare the yearly results with the reported cases of typhus. The following conclusions were drawn from it. On the assumption that case prevalence is a function of vector prevalence, *L. nuttalli* cannot be an important vector because it was most abundant in the year when the reported number of cases was lowest and because its abundance was not related to season. *E. gallinacea, P. spinulosa* and *B. bacoti* do not in general appear to be numerous enough to account for the number of typhus cases. *X. cheopis* and *O. puertoricensis*, particularly the former, seem to meet the requirements for vectors in that they showed a drop in abundance from year to year corresponding with the drop in cases and they also suggest a seasonal variation that is in accord with the seasonal variation of the disease, especially if the percentage of rats infested is taken as a gauge of abundance.

Davis (G. E.). **Parthenogenesis in the Argasid Tick** *Ornithodoros moubata* **(Murray, 1877).**—*J. Parasit.* **37** no. 1 pp. 99–101, 9 refs. Lancaster, Pa., 1951.

References are cited to the occurrence of parthenogenetic reproduction in Ixodid ticks. No authenticated case of parthenogenesis in an Argasid is known to have been recorded in the literature. In the course of observations on 317 individually reared females of *Ornithodoros moubata* (Murr.), 90 were found to have oviposited without mating and some at least of the eggs of 18 were viable. Of the 48 larvae that hatched, 38 were reared to the adult stage. All were females. When a parthenogenetic female was allowed to mate with a normal male, both sexes were represented in the progeny. Oviposition in unfertilised females was much delayed, the number of eggs laid was small and the interval between hatching and moulting of their progeny was much prolonged.

Micks (D. W.). **The Laboratory Rearing of the common Fowl Tick,** *Argas persicus* **(Oken).**—*J. Parasit.* **37** no. 1 pp. 102–105, 1 fig., 5 refs. Lancaster, Pa., 1951.

A method is described by which *Argas persicus* (Oken) can be reared in relatively large numbers in a small space with a minimum of attention. The colony was established in a can 11½ ins. high and 7½ ins. in diameter. Four holes 2 ins. in diameter were punched in the tight-fitting lid, which was covered with muslin kept in place with glue. The lid was secured with adhesive tape. A half-inch layer of wood shavings was put in the can and on top of this a number of disks of Cellotex with a diameter one inch less than that of the can. The disks were originally ½ in. thick and were cut in half in the horizontal plane with an instrument blunt enough to leave a rough irregular surface for the ticks to grasp during moulting. About 15 disks were kept together, almost touching, by means of a wooden rod passed through a hole bored in the centre of each and allowed to project at one end to form a handle. The colony of ticks was fed by placing a young fowl in the can overnight or for a few hours during the day. Daytime feeding was possible as very little light entered the can. Unless very few ticks were present, the fowl was placed in the container at fairly frequent intervals or alternated with another to avoid death by exsanguination. This was particularly important if young chicks were used. When a large number of larvae was seen on the uppermost disk or on the underside of the lid, a fowl was introduced and left until all became attached. It was then removed and, if no nymphs or adults were still feeding on it, was placed in a suitable small cage. With few exceptions, the larvae completed engorgement in five days. Therefore, on the afternoon of the fifth day, the host was transferred to a container having wood shavings in the bottom, a heavy wire platform above these and a cover of muslin secured by a rubber band. The larvae were collected next morning from the top of the container or the shavings, and if any had not dropped, the procedure was repeated.

The colony was maintained at 25–28°C. [77–82·4°F.] and a relative humidity of 70–80 per cent. About 5–6 days after a complete blood-meal, eggs were laid in batches averaging more than 100. The larvae hatched in 14–18 days and were ready for a blood-meal soon afterwards, but could live for two months without one. They completed engorgement in five days (or longer at lower temperatures) and moulted about one week later. Subsequent stages fed very rapidly, requiring 15–120 minutes according to stage. Each of the two nymphal stages lasted 12–14 days. The adults fed readily every 25–28 days, and a batch of eggs was laid after each feeding. Both nymphs and adults fed largely on the legs and feet of the host, whereas larvae attached themselves

in areas where the skin was thin and readily penetrated. One or more of the disks could easily be removed to obtain desired stages. Engorged females, when put in stoppered vials or test tubes, laid batches of eggs very readily and all the progeny of one tick could thereby be isolated.

Hofstad (M. S.). **Recovery of Newcastle Disease (Pneumoencephalitis) Virus from Mites,** *Liponyssus sylviarum,* **after feeding upon Newcastle-infected Chickens.**—*Amer. J. vet. Res.* **10** no. 37 pp. 370–371, 4 refs. Chicago, Ill., 1949.

As the virus of Western equine encephalitis has been recovered from *Leiognathus* (*Liponyssus*) *sylviarum* (C. & F.) in California [*R.A.E.*, B **38** 37], experiments were made on the ability of this mite to take up and transmit the virus of Newcastle disease of poultry. Fowls with well-established infestations of mites were inoculated with the virus and killed 4–7 days later. The virus was isolated from washed mites from the fowls killed on the fourth day and from one batch of fowls killed on the sixth day but not from those from another fowl killed on the sixth day nor from a batch killed on the seventh day. Mites taken from the experimentally inoculated birds at the same time as those used for virus isolation failed to infect susceptible fowls to which they were transferred. These results indicate that the virus can occur in *L. sylviarum* during the period of viraemia in the host, but does not persist in it. The possibility that *Dermanyssus gallinae* (Deg.) may be of more importance in the spread of Newcastle disease should be investigated, since the viruses of both St. Louis and western equine encephalitis have been found in this mite [**33** 25, 89], and experiments have shown that the St. Louis virus persists in it from generation to generation [**33** 178] and can be transmitted by it to fowls.

Eskey (C. R.), Prince (F. M.) & Fuller (F. B.). **Double Infection of the Rat Fleas** *X. cheopis* **and** *N. fasciatus* **with** *Pasteurella* **and** *Salmonella.*—*Publ. Hlth Rep.* **66** no. 41 pp. 1318–1326, 2 refs. Washington, D.C., 1951.

The following is virtually the authors' summary. It was shown in the investigation described that the domestic rat fleas, *Xenopsylla cheopis* (Roths.) and *Nosopsyllus fasciatus* (Bosc), can be infected with both plague bacilli and *Salmonella* at the same time and that such fleas may transmit either infection. However, their ability to transmit plague was greatly reduced by the complicating *Salmonella* infection.

Fleas naturally infected with *Salmonella* were collected from domestic rats and wild rodents in many different areas in the western United States. Salmonellosis is thus shown to be widely disseminated among rodents. It is possible that *Salmonella* epizootics may sometimes modify the course of plague among a rodent population subjected to both.

Seghetti (L.) & Firehammer (B. D.). **High Pressure Sprays in Control of the Sheep Tick** (*Melophagus ovinus* **Linn.**).—*J. Amer. vet. med. Ass.* **117** no. 885 pp. 447–449, 2 figs., 1 ref. Chicago, Ill., 1950.

The experiments described were carried out in Montana to compare two methods for spraying sheep for the control of *Melophagus ovinus* (L.) in autumn. Infested lambs in full fleece were sprayed in November. Satisfactory control was obtained by thoroughly wetting the lambs with sprays delivered from a hand-operated power sprayer with multiple outlet spray gun ; DDT, toxaphene and chlordan at 0·5 per cent. and γ benzene hexachloride at 0·06 per cent. had reduced infestation (numbers of live keds per lamb) by 96·5, 97·3, 98·6 and 96·4 per cent., respectively, after ten days and by 96·9, 100, 99·8 and 99·6 per cent. after

40 days. Treatment by passing the lambs through a rectangular frame formed by a spray boom in a chute was ineffective ; only 33·9 and 8·3 per cent. reduction in infestation after ten and 40 days was obtained with 0·06 per cent. γ benzene hexachloride. Similar results were obtained on another occasion when several hundred lambs were sprayed with a boom using 0·5 per cent. DDT.

Bosman (S. W.), Botha (M. L.) & Louw (D. J.). **Effect of the Ked on Merino Sheep.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 281, 59 pp., 21 figs., 3 graphs, 1 diagr., 6 refs. Pretoria, 1950.

An account is given of experiments carried out to determine the extent to which infestation by *Melophagus ovinus* (L.) is injurious to the health of merino sheep in South Africa or to the quantity or quality of wool produced. It was shown that the likelihood of infestation developing and its injurious effect depend principally on the feeding standard of the sheep. Well-fed sheep did not readily become infested, though individuals varied greatly in this respect, and infestation did not adversely affect their weight. The clean-yield (weight of dry wool as a percentage of grease wool) was significantly reduced by infestation, but the production of grease wool was significantly increased, and there was no difference in the whiteness or decrease in the quantity of scoured wool. Although trade valuers discriminated against fleeces from infested sheep (which they did not know to have been infested), no economically detrimental characteristics were established in the wool.

When the standard of feeding was poorer, resembling that found under conditions on the veldt at certain seasons, infestation affected the health of the sheep, and some died. Infestation did not appreciably raise the production of grease wool, and there was an appreciable drop in the clean-yield percentage, but no important decrease in production of scoured wool was found in the infested groups. Trade valuers discriminated strongly against wool produced by infested sheep under poor feeding conditions.

These results showed that *M. ovinus* constitutes a problem of national importance in South Africa and that energetic action for its extermination is justified. Appropriate measures are suggested.

Papers noticed by Title only.

Schrader (G.). **Die Entwicklung neuer Insektizide auf Grundlage organischer Fluor- und Phosphor-Verbindungen.** [The Development of new Insecticides on the Basis of organic Fluorine and Phosphorus Compounds.]—*Monogr. angew. Chem. & Chem.-Ing.-Tech.* no. 62, 2nd edn., 96 pp., 4 graphs, 10 pp. refs. Weinheim/Bergstr., Verlag Chemie, 1952. Price *DM.* 8.50. [See *R.A.E.*, A **40** 325.]

Vinson (E. B.) & Kearns (C. W.). **Temperature and the Action of DDT on the American Roach** [*Periplaneta americana* (L.)].—*J. econ. Ent.* **45** no. 3 pp. 484–496, 4 graphs, 12 refs. Menasha, Wis., 1952. [See *R.A.E.*, A **40** 345.]

von Kéler (S.). **Bemerkungen zu Eichlers " Ergänzung " meiner " Übersicht über die gesamte Literatur der Mallophagen."** [Remarks on Eichler's " Supplement " to my " A Survey of the Literature on the Mallophaga".]—*Z. angew. Ent.* **32** pt. 4 pp. 610–612. Berlin, 1951. [*Cf. R.A.E.*, B **40** 104.]

Hassall (A.), Doss (M. A.) & Humphrey (J. M.). **Index-catalogue of Medical and Veterinary Zoology. Part 15. Authors : Si to Szyszkowski.**—pp. 4677–4985. Washington, D.C., U.S. Dep. Agric., 1951. Price $1.25 (from Supt. Documents). [*Cf. R.A.E.*, B **39** 176.]

FIEDLER (O. G. H.). **The South African Biting Midges of the Genus *Culicoides* (Ceratopogonid., Dipt.).**—*Onderstepoort J. vet. Res.* **25** no. 2 pp. 3–33, 178 figs. Pretoria, 1951.

The Ceratopogonids of the genus *Culicoides* came into prominence in South Africa when they were shown to be vectors of the viruses of horse-sickness of equines and blue-tongue of sheep [*R.A.E.*, B **33** 27]. The species of the genus occurring in the Union of South Africa and Southern Rhodesia are therefore reviewed ; 22 species are recognised of which one is described as new. Notes are given on the distribution and prevalence of each species and the characters and synonymy of some of them, and a field key to them is appended. It is concluded that *C. lugens* Kieff. [**9** 106] is a synonym of *C. milnei* Aust., that *C. praetermissus* Cart., Ingr. & Macf. [**9** 26] is a variety of *C. distinctipennis* Aust., and that *C. distinctipennis* var. *egypti* Macf. [**12** 161] is a synonym of *C. d. praetermissus*.

FENNER (F.), DAY (M. F.) & WOODROOFE (G. M.). **The Mechanism of the Transmission of Myxomatosis in the European Rabbit (*Oryctolagus cuniculus*) by the Mosquito *Aëdes aegypti*.**—*Aust. J. exp. Biol. med. Sci.* **30** pt. 2 pp. 139–152, 13 refs. Adelaide, 1952.

A sudden and widespread epizootic of myxomatosis [*cf.* *R.A.E.*, B **33** 117] occurred among wild rabbits (*Oryctolagus cuniculus*) in south-eastern Australia in the first three months of 1951, and field evidence suggested that the explosive outbreaks that marked it were due to mosquito transmission [*cf.* **33** 42, 118]. Experiments on the mechanism of transmission by mosquitos were therefore carried out ; the mosquito used was *Aëdes aegypti* (L.), and no attempt was made to simulate natural conditions of transmission, as this species is not concerned with it in Australia. The object was to determine whether a biological cycle is involved and whether the virus in the blood-stream of the rabbit is important, and the experiments included tests of transmission by feeding, tests of the occurrence of the virus in the mosquitos and in or on the mouth-parts by inoculations of suspensions of the body or head and proboscis into healthy rabbits, and tests of mechanical transmission from rabbit to rabbit by pin-prick. The materials and methods used are described.

The following is mainly based on the authors' summary of the results. Females of *A. aegypti* that fed on the ear of a rabbit infected with myxoma virus six days earlier by inoculation in the flank ingested virus with the blood but failed to transmit the disease, whether tested within a few minutes or at intervals up to 29 days after the infective feed. No virus could be detected in their heads or mouth-parts. Pins stuck into the ear of the same rabbit at the same time also failed to transfer the infection. Females that fed on the skin lesion of a rabbit infected eight days earlier, ingested virus with the blood and some also contaminated their mouth-parts with virus. Positive transfers were obtained at intervals varying from a few minutes (interrupted feeding) to 25 days after the feed on the skin lesion. Pins stuck into the same lesion transferred the infection at intervals varying from a few minutes to 12 days.

The probability that a mosquito would become infected when probing through a skin lesion increased with the age of the lesion ; with well developed lesions, between 60 and 70 per cent. of the mosquitos became infectious. The probability that a mosquito with a contaminated proboscis would successfully transfer the disease diminished as the interval between the infective feed and a subsequent feed increased. Negative results not infrequently intervened between two positives. Titration of dissected mosquitos provided no evidence for either a transfer of virus from the gut to the haemocoele, or for multiplication

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of the virus in the mosquito. No infection of rabbits was obtained by inoculation of larvae or inoculation or feeding of adults that were the offspring of females that had fed on the ear or lesion of an infected rabbit and had received no other blood-meal.

Transmission of myxomatosis by *A. aegypti* is thus purely mechanical and is due to contamination of the mouth-parts of the mosquito with virus during penetration of the virus-infected skin of an infected rabbit. With respect to its ability to transmit myxomatosis, *A. aegypti* is essentially a flying pin. The important rabbits from the epidemiological point of view, therefore, are those on which skin lesions are numerous and extensive. In the field, some rabbits with advanced myxomatosis and many skin tumours can always be found in any area in which spread is active.

Causey (O. R.), Kumm (H. W.) & Laemmert jr. (H. W.). **Dispersion of Forest Mosquitoes in Brazil : further Studies.**—*Amer. J. trop. Med.* **30** no. 2 pp. 301–312, 4 figs., 2 refs. Baltimore, Md., 1950.

The following is substantially the authors' summary. Further studies in Minas Gerais, Brazil, of the dispersal of sylvan mosquitos marked with bronzing powders confirmed and extended the observations previously reported [*R.A.E.*, B **39** 196]. The same technique was used as in the earlier work, but a wider area was searched. *Haemagogus spegazzinii* Brèthes, perhaps the most important vector of jungle yellow fever in Brazil [*cf.* **38** 92 ; **39** 173], was recaptured over 7 miles from the point of release, and *Aëdes leucocelaenus* Dyar & Shann., another efficient vector, over 3½ miles from it. Out of a total of 7,624 marked adults of *H. spegazzinii* released, 98 were recaptured. Other species recovered at long distances were *A. serratus* (Theo.) more than 7 miles from the place of release, *Psorophora ferox* (Humboldt) at nearly 7 miles, *Wyeomyia* sp. and *A. terrens* (Wlk.) at about 3½ miles and *Chagasia* sp. at about 1½ miles. The longest survival recorded is that of *P. ferox*, an individual of which was found 55 days after release.

It is tentatively inferred from the findings that yellow-fever virus may be disseminated by the movement of vectors in regions of small residual forests surrounded by open pasture land and cultivated fields, as typified by the country in western Minas Gerais.

An additional series of experiments showed that forest mosquitos travel in the directions of the prevailing winds during the hours of daylight. On no occasion was a marked mosquito recaptured in a forest that could have been reached only by flight against the wind.

Logan (J. A.). *Anopheles labranchiae* **Eradication in Sardinia : an interim Report.**—*Amer. J. trop. Med.* **30** no. 2 pp. 313–323, 4 figs., 2 refs. Baltimore, Md., 1950.

The topography of Sardinia is described, and an account is given of the organisation of measures begun in 1946 for the eradication of *Anopheles maculipennis* var. *labranchiae* Flni., the only recognised vector of malaria [*cf. R.A.E.*, B **38** 130, 215]. The initial survey, made in 1946, showed that this mosquito occurred throughout the island and might breed in any type of water. The control measures were spraying against the overwintering females with 5 per cent. DDT to leave a deposit of 2 gm. per sq. metre, treatment of churches and large storage buildings by the use of the TIFA fog applicator [**35** 128] or DDT smoke candles, and weekly treatment of breeding places with 2·5 per cent. DDT plus 0·5 per cent. Triton in fuel oil. The intended rate of application of the larvicide was 0·1 lb. per acre, but the actual rate was much higher. Much

preliminary preparation of the water surfaces by clearing and ditching was necessary. The difficulties met with and the financing of the work are described.

The results obtained up to September 1949 are shown in charts. It appeared at that time that malaria transmission had been eliminated from Sardinia, which was previously one of the most highly malarious regions of the world. No primary case was verified in 1949, and the number of relapses was considerably reduced. *A. m. labranchiae* still occurred in some sectors but appeared to have been eliminated from the greater part of the island.

Flies [*Musca domestica* L.] had to be controlled in order to hold public support for the campaign. Because of the presence of DDT-resistant strains, small quantities of chlordan were used for this. Single applications of spray depositing 0·4 or 0·8 gm. chlordan per sq. metre in limited areas of houses and out-buildings gave adequate control, sometimes extending into the second year.

DE ZULUETA (J.). **A Study of the Habits of the adult Mosquitoes dwelling in the Savannas of eastern Colombia.**—*Amer. J. trop. Med.* **30** no. 2 pp. 325–339, 5 figs., 8 refs. Baltimore, Md., 1950.

The following is based on the author's summary. Observations on the habits of the adult mosquitos in the grass plains of eastern Colombia were made during the rainy season, in the months of June, July and November 1948 and June 1949. The mosquitos were caught in stable traps [*R.A.E.*, B **33** 97] and in muslin tents covering 4 sq. metres of ground, and nets fixed to a moving vehicle were used to catch them in flight.

The tent catches were made in series along a straight line stretching from a breeding place to the middle of an expanse of savannah and always between 7 a.m. and 5 p.m. The tent was suspended on poles fixed into the ground, the muslin sides were quickly lowered and the grass beneath was sprayed with a repellent to disturb the resting mosquitos, which were then caught on the muslin. The process took 15–20 minutes. In a total of 104 tent-catches, the average numbers of mosquitos and Anophelines were 11·9 and 1·2. These represent roughly 7,680,000 mosquitos and 760,000 Anophelines per sq. mile. Both sexes of *Anopheles peryassui* D. & K., *A. pessoai* Galvão & Lane and *A. parvus* (Chagas) and one male of *A. punctimacula* D. & K. were found resting in the grass. The commonest mosquitos of other genera were two species of *Culex* and *Psorophora confinnis* (Lynch Arrib.). Direct observation showed that the mosquitos were usually resting in the grass at no more than 4 ins. above ground.

In the 104 tent catches, 30 male and 98 female Anophelines and 570 males and 536 females of other mosquitos were taken. This indicated a similar span of life in the two sexes in the latter. The number of Anophelines was too small for definite conclusions on survival. The average fertilisation rate among all females from the tent catches was 81 per cent., which indicates that mating probably occurs shortly after emergence. Anywhere in the plains, breeding places could usually be found within about ½–1 mile. Density of female mosquitos was nearly uniform across the savannahs, but males were most plentiful near the breeding places. Such findings show that, at least during the rainy season, any part of the savannahs is within the effective flight-range of the species living there. A series of parallel stable-trap catches made near a breeding area and rather more than half a mile away showed about the same mosquito density for both situations.

Anophelines formed 73 per cent. of the mosquitos caught in the stable traps as compared with 19 per cent. in the tents. The species composition of the catch in a stable trap was not materially altered by changing the bait, but the

numbers taken appeared to be related to the bulk of the bait. Tent catches and catches from a moving vehicle were both superior in providing direct information on the real mosquito density and on the composition of the mosquito fauna. A survey of biting activity over a period of 24 hours measured in a baited trap showed that activity was greatest shortly after sunset and continued to a slight extent during the night with a small increase before sunrise, but was negligible during the day. Swarming and mating of Anophelines were observed only on two occasions, both at 7 p.m. about the end of the peak biting time, when the swarming males caught were *A. peryassui*. Swarms of other mosquitos were seen two hours earlier.

BAILEY (S. F.) & SMITH (L. M.). **Handbook of agricultural Pest Control.**—$7\frac{1}{2} \times 5$ ins., 191 pp., 1 fig. New York, N.Y., Industry Publ., Inc., 1951. Price $3.25 or (foreign and Canada) $3.75.

This handbook, which is noticed more fully elsewhere [*R.A.E.*, A **40** 371], includes a chapter on mosquito control, with reference tables and formulae for calculating rates of application per unit area or volume of larvicides applied as sprays, from drip cans and from aircraft and of aerosols, space sprays and deposit sprays against the adults, and a very brief section on dipping of livestock, showing the calculations necessary for obtaining and maintaining the desired concentrations of toxicant in dips.

DAVIDSON (G.). **A Field Study on "Gammexane" and Malaria Control in the Belgian Congo. II. The Effect of the Spraying of Houses with "Gammexane" on the Mosquito Population and on the Malaria Incidence in Children.**—*Ann. trop. Med. Parasit.* **44** no. 1 pp. 1–26, 5 figs., 7 refs. Liverpool, 1950.

Tests of the effect on Anopheline populations and malaria rates of spray-deposits of BHC (benzene hexachloride) in houses were made in 1948 in a camp in the Yaligimba plantation [*R.A.E.*, B **40** 126] and in several villages to the south of the plantation. Four applications of spray, at intervals of 2–3 months, were made in the camp, and four or five in some of the villages. Observations on mortality amongst mosquitos caught alive in treated houses and amongst those artificially applied to treated surfaces indicated that deposits of rather more than 10 mg. γ BHC per sq. ft. from a water-dispersible powder containing 6·5 per cent. γ BHC (calculated from areas sprayed and volumes of spray used) retained their toxicity to adults of *Anopheles moucheti* Evans for three months. A deposit from a corresponding amount of powder containing 10 per cent. γ BHC retained its toxicity for only about two months, presumably because poor dispersion gave a lower deposit. Little direct evidence was obtained on the effect of treatment on *A. gambiae* Giles, as the density of this mosquito was low throughout the area. However, its continued scarcity in treated houses near numerous verified breeding-places produced by flooding in November 1948 indicated effective control. Although mosquitos resting in houses during the day-time remained negligible in numbers four months after the third and fourth treatments at the camp, significant numbers were entering, biting and leaving before that time. This indicates that after about three months, the insecticide loses its toxicity to such an extent that mosquitos that spend only a part of the night in the treated houses leave before acquiring a lethal dose, but those that remain the next day are killed. To determine accurately the duration of effectiveness of deposits, collections of mosquitos by window-traps and net-traps and observations on the mortalities among living mosquitos caught by those methods are essential. Collection by spraying with an insecticide giving rapid knockdown does not give an accurate indication,

In contradiction to the findings with *A. gambiae* in Sierra Leone [**39** 21], it was observed that untreated houses in a treated village continued to harbour large numbers of *A. moucheti*. Treatment of every house is thus essential for effective control. No evidence was obtained of eradication of *A. moucheti* by house-spraying from villages as much as two miles from the nearest untreated village. This may be because the flight-range of this species is more than two miles or because larvae are brought into the treated areas by the flowing water in which they breed. A study of stomach and ovary conditions among females of *A. moucheti* caught in treated and untreated villages showed that the treatment reduced the age of the population to the extent of preventing many females from maturing and laying their eggs and reducing the biting-rate. Extensive salivary-gland examinations in treated and untreated villages indicated that treatment stopped the transmission of malaria. The sprays had virtually no effect against *Mansonia* (*Taeniorhynchus*) *africana* (Theo.).

Blood-film examinations of children in treated villages, nine months and one year after the first of four or five applications of spray, showed little change in the parasite-rates but a significant decrease in the intensity of the infections. Substantial reductions in parasite-rates could not be expected so soon. Examinations in the control villages indicated that the parasite-rates and parasite intensities among children there were higher one year after the beginning of treatment in the treated villages than at the beginning of the observations. No significant difference was found between infant infection-rates in treated and in untreated villages. In general, it is thought that the great amount of movement of population that occurs throughout the area would tend to nullify the effect of treatment on the malaria incidence in particular parts of the area.

Fairbairn (H.) & Culwick (A. T.). **Some climatic Factors influencing Populations of** *Glossina swynnertoni*.—*Ann. trop. Med. Parasit.* **44** no. 1 pp. 27–33, 4 graphs, 4 refs. Liverpool, 1950.

It is shown by calculations based on observations over a number of years at Shinyanga, Tanganyika, that the apparent density of *Glossina swynnertoni* Aust., as estimated from routine fly rounds in a block, changes with the soil temperature at a depth of 1 ft. two months before, and that annual departures from the densities to be expected from soil temperatures are associated with differences in annual rainfall. The optimum soil temperature, and the range over which apparent fly density increases on the average are 29 and 27·1–30·9°C. [84·2 and 80·78–87·62°F.], and density is negatively correlated with rainfall. It is pointed out that soil temperature at a depth of 1 ft. can have no direct effect on the fly, and that the temperature-rainfall complex is probably only an index of other factors that directly control its numbers and activity.

Bertram (D. S.). **Studies on the Transmission of Cotton Rat Filariasis. II. Factors influencing the Efficiency of the Vector,** *Liponyssus bacoti* **; with a statistical Analysis by P. Armitage.**—*Ann. trop. Med. Parasit.* **44** no. 1 pp. 55–83, 11 graphs, 14 refs. Liverpool, 1950.

The previous paper of this series [*R.A.E.*, B **40** 124], was concerned with the nature of infections obtained in individuals of *Bdellonyssus* (*Liponyssus*) *bacoti* (Hirst), fed on cotton rats [*Sigmodon hispidus*] infected with *Litomosoides carinii*. The subject of the present paper is the relation between the number of microfilariae in the peripheral blood of the donor cotton rat and the infection-rates (percentages infected) in batches of the mite. The following is taken from the author's summary. In the case of mites fed on cotton rats that had been exposed to infection only once, the infection-rates increased rapidly to about 60 as the microfilarial density in the rodent's peripheral blood rose from 0 to about 200 mf. (number of microfilariae per cu. mm. blood) but only slowly and not to more than about 86 as the density rose from 200 to 1,200 mf. This is attributed to the presence of increasing numbers of non-infective microfilariae

in heavy infections. Infection in the cotton rat following one exposure may last 15 months or more, but the mf. peak occurs about the 150th day. A small infection of adult worms gives rise to a low mf. (200 or less), with only a slight peak or none. A heavier adult infection results in a higher mf., with marked peaks of 1,000 or more. Heavily infected cotton rats are much less infective during their peak period than their mf. would suggest, and lightly infected ones more so, with the result that infection-rates of 50–80 are characteristic of the peak period, although the mf. may vary from 60 to 1,200. However, the marked suppression of infectivity in the heavily infected cotton rats does not persist as the mf. falls during the last months of infection, and the cotton rats remain quite highly infective.

In cotton rats that had been exposed for 6–12 months to repeated reinfection, densities of 1,000–3,000 mf. about the 300th and 500th days of blood infection induced mite infection-rates of only 7·9–39·3. It is assumed that repeated reinfection with adult worms results in continuous production of microfilariae over many months with numerous overlapping peak periods of microfilariae in the circulation and intensification of the activity of the suppressive factor. However, a cotton rat that was exposed to three separate infections at intervals of eight and four months and developed a high mf., induced infection-rates of 84·6–97·9 in the mites between the 200th and 600th days. The consistently high infectivity of this cotton rat is attributed to the fact that, as there were only three widely separated adult infections, the mf. peaks were far apart and the suppressive action associated with one peak period lost its maximum effectiveness before it was reinforced by re-stimulation during the succeeding peak.

The nature and mode of action of the suppressive factor are uncertain. The efficiency of the mite as a vector is influenced by the fact that most mites take up fewer microfilariae than are available to them in a cotton rat's circulation [*cf. loc. cit.*] and by the rapid increase in numbers of non-infective microfilariae in infections exceeding about 200 mf. These factors reduce the probability that all mites in a batch will become infected and limit the numbers of infective forms in an individual mite. It also follows that the transmission from heavily infected cotton rats is only slightly more efficient than from lightly infected ones. Repeated reinfection of the cotton rat, as is likely in nature, is accompanied, despite heavy blood infections, by a reduction in its infectivity and therefore in its epidemiological importance.

Batches of mites of which the individuals contain uniform numbers of worms are needed for precise quantitative transmission. Cotton rats with blood infections of less than 200 mf. and up to 50–60 days old are most likely to provide these, since they induce infection-rates in the mite of less than 50, with which are coupled individual infections of 1–5 or, less usually, about 10 worms [*cf. loc. cit.*]. Cotton rats with blood infections between 60 and 200 days old are likely to give infection-rates up to 86·4, and individual infections of up to 78 worms. Such cotton rats are indicated as donors for transmission work in which certainty rather than precision is desired. The infectivity of cotton rats with blood infections older than about 200 days is less predictable. Cotton rats with certain types of multiple infections are suitable donors for general or for precise transmission, but involve unnecessary additional preparatory work when cotton rats with single infections are available.

GRIFFITHS (R. B.) & O'ROURKE (F. J.). **Observations on the Lesions caused by *Cnemidocoptes mutans* and their Treatment, with special Reference to the Use of "Gammexane".**—*Ann. trop. Med. Parasit.* **44** no. 1 pp. 93–100, 3 pls., 15 refs. Liverpool, 1950.

Cnemidocoptes mutans (Rob. & Lanq.) is common on fowls in Britain. Literature on the clinical signs of infestation, which appears to be confined to the legs

and feet, and methods of treatment is briefly reviewed, a classification of the lesions of scaly leg, the condition caused by the mite, is suggested, and the condition, as seen in 238 cases in fowls on two farms in western England, is described. The legs of affected birds were treated with various formulations of BHC (benzene hexachloride) and at the same time the houses of one of the two flocks were sprayed to give a deposit of 200 mg. γ BHC per sq. ft. This, however, appeared from the results to be superflous. The most suitable material for dressing the fowls seemed to be a solution of 5 per cent. γ BHC in miscible oil, diluted with water to give a strength of 0·1 per cent. γ BHC. Mild and moderate cases were cured with one dressing. Severe cases needed two applications, which are probably best given at an interval of a fortnight. In view of the difficulty of finding the mites themselves and the slight lesions in early infestations, it is thought advisable to treat all birds in infested flocks. The removal of scabs had little effect on the results but was probably justified in the case of those that came away easily.

Dicke (R. J.), Pope (A. L.), Bray (R. W.) & Hanning (F.). **Investigation of Rotenone and Benzene Hexachloride Dusts for the Control of Insect Ectoparasites on Sheep.**—*J. agric. Res.* **78** no. 12 pp. 565–569, 5 refs. Washington, D. C., 1949.

In experiments in Wisconsin, sheep infested with *Melophagus ovinus* (L.) and *Damalinia* (*Trichodectes*) *ovis* (Schrank) were treated in April and May before shearing with a dust containing 1 per cent. γ BHC (benzene hexachloride) or one containing 1 per cent. rotenone and 2 per cent. oil conditioner. They were applied with a rotary hand duster at a rate of 4 oz. per ewe or 1 oz. per lamb. Both gave complete control of *D. ovis* and an effective control of adults of *M. ovinus* over an observation period of 34 days. Neither was effective against pupae of *M. ovinus*. Rotenone seemed to be rather better than BHC in preventing reinfestation with emerging adults.

Shorn sheep were dusted with 1 per cent. γ BHC, 10 days, two weeks or one month before slaughter, to determine whether the treatment affected the palatibility of fat or muscle. Tasting tests failed to reveal taints in meat from treated animals more pronounced than differences in flavour resulting from variation in quality.

Haberman (W. O.), Morgan (B. B.) & Dicke (R. J.). **The Occurrence of *Hypoderma* Larvae in the Spinal Canal of Cattle.**—*J. agric. Res.* **78** no. 12 pp. 637–640, 21 refs. Washington, D. C., 1949.

The occurrence of *Hypoderma* larvae in the spinal canal of cattle was discovered in Germany in 1888 and has since been recorded several times, but few observations have been made in North America. The various records are reviewed. In the case of those made before 1921, the species involved is not certain, but later ones indicate that it is usually *H. bovis* (Deg.) and only very rarely *H. lineatum* (Vill.).

The fatty connective tissue that lies between the periosteum and the dura mater in the spinal canal was removed from large numbers of cattle slaughtered in Wisconsin in 1947 and 1948 and examined for the presence of larvae. Of 982 larvae removed from 293 infested spinal canals, 975 were identified as *H. bovis* and 7 as *H. lineatum*. The greatest number removed from one spinal canal was 21. A progressive increase in the average length of the larvae was noted from September (7·5 mm.) to May (15·6 mm.). The cattle examined included some from areas where *H. lineatum* is the prevalent species. In an examination of a comparable group of animals during the same period, 981 of 982 larvae removed from infested oesophagi were *H. lineatum* and only one *H. bovis*.

Dikmans (G.). **The Transmission of Anaplasmosis.**—*Amer. J. vet. Res.* **11** no. 38 pp. 5–16, 47 refs. Chicago, Ill., 1950.

Data from the literature on the transmission of anaplasmosis of cattle are reviewed, and tables are given showing the species of ticks with which experiments on transmission have been recorded, the stages used, the results obtained, and the authorities for the records, and the insects that have been tested as mechanical vectors, the results obtained and the authorities.

Choudhury (B.) & Robinson (V. B.). **Clinical and pathologic Effects produced in Goats by the Ingestion of toxic Amounts of Chlordan and Toxaphene.**—*Amer. J. vet. Res.* **11** no. 38 pp. 50–57, 3 figs., 22 refs. Chicago, Ill., 1950.

In experiments in which chlordan and toxaphene were administered orally to goats, both as 40 per cent. powders, three goats that received 750 mg. chlordan per kg. body weight daily died after 70, 68 and 28 hours, respectively. A goat that received 25 mg. toxaphene per kg. daily for four days, 37·5 mg. per kg. on the fifth and sixth days, 50 on the seventh day, 75 on the eighth, 100 on the ninth and tenth and 150 on the 11th day died on the morning of the 11th day, one that received 100 mg. toxaphene per kg. on the first and second days and 150 mg. per kg. on the third day died on the fourth day, and the remaining goat died on the day after receiving one dose of 150 mg. toxaphene per kg. The symptoms observed and the pathological lesions revealed at autopsy are described in detail.

Rosenberg (M. M.) & Adler (H. E.). **Comparative Toxicity of DDT and Chlordan to young Chicks.**—*Amer. J. vet. Res.* **11** no. 38 pp. 142–144, 9 refs. Chicago, Ill., 1950.

Rosenberg (M. M.) & Tanaka (T.). **Toxicity of Chlordan to growing Chickens.**—*T. c.* no. 39 pp. 233–235, 1 ref.

Rosenberg (M. M.), Tanaka (T.) & Adler (H. E.). **Toxicity of Chlordan to laying Pullets.**—*T. c.* pp. 236–239, 4 refs.

It has recently been noticed in Hawaii that chicks brooded on litter (bagasse) treated with a spray containing 1 lb. DDT, 1 lb. chlordan and 1·25 oz. lethane B-72 (13·5 per cent. by weight β,β′-dithiocyanodiethyl ether and 86·5 per cent. inert material) in 2·5 U.S. gals. water [*cf.* also *R.A.E.*, B **40** 36] fed on the bagasse and suffered heavy mortality. The symptoms and the lesions observed at autopsy are briefly described. As unsprayed bagasse, when fed to chicks for a short time, had no adverse effect and the spray suspension alone produced similar symptoms, some of which were different from those recorded in the literature for DDT poisoning, comparative studies of the effect of the three insecticides on chicks were made and are described in the first paper. DDT and chlordan were added to the daily ration at 0·25 and 0·5 per cent. and lethane at 0·25 and 0·125 per cent., starting when the chicks were a week old. The lethane caused no mortality in 14 days, but the chicks receiving chlordan died within 24–96 hours and those receiving DDT within 36–162 hours. The symptoms induced by chlordan were different from those caused by DDT, but neither appeared characteristic. There were no definite pathological changes ascribable to either insecticide.

In the experiments described in the second paper, chicks seven days old were fed on rations containing chlordan for 14 days and those 21, 63 and 112 days old for 21 days. The youngest chicks were all killed by chlordan at 0·1–0·25 per cent. of the total ration, some of them within two days, and 0·05 per cent. chlordan killed 14 out of 21 within 14 days. Resistance increased markedly with age. The earliest deaths caused by 0·25 per cent. occurred in 1–2, 2–3,

4–5 and 8–9 days for chicks 7, 21, 63 and 112 days old, respectively, and this amount killed almost all of all the age groups when given for 21 days. The primary lesions of chicks that died were in the heart.

In the third paper, it is recorded that laying pullets given food containing chlordan for 28 days responded by moulting, ceasing to lay, eating less and losing weight. The response increased in proportion to the quantity given. Pullets receiving rations containing 0·5 and 0·25 per cent. ceased laying within 5 and 8–14 days, respectively, and those receiving 0·15 per cent. lowered production by 54·5 per cent. within 28 days, whereas those receiving 0·05 per cent. continued to lay nearly as well as the controls. All the birds survived the treatment except one of the four that received 0·5 per cent. and one of the four that received 0·25 per cent., which died on the 21st and 27th days, respectively. Postmortem inspection of control birds and birds receiving 0·05 and 0·15 per cent. chlordan did not reveal any lesions of disease, but some of the pullets in the last group had quiescent oviducts and ovaries. The birds receiving higher concentrations were also emaciated, but only the two that died showed pericarditis and distortion of the heart.

Schwabe (C. W.). **Observations on the Life History of *Pycnoscelus surinamensis* (Linn.), the intermediate Host of the Chicken Eyeworm in Hawaii.**—*Proc. Hawaii. ent. Soc.* **13** no. 3 pp. 433–436, 21 refs. Honolulu, 1949. **Studies on *Oxyspirura mansoni*, the Tropical Eyeworm of Poultry. II. Life History.**—*Pacif. Sci.* **5** no. 1 pp. 18–35, 10 figs., 27 refs. Honolulu, 1951. **III. Preliminary Observations on Eyeworm Pathogenicity.**—*Amer. J. vet. Res.* **11** no. 40 pp. 286–290, 2 figs., 12 refs. Chicago, Ill., 1950. **IV. Methods for Control.**—*Proc. Hawaii. ent. Soc.* **14** no. 1 pp. 175–183, 3 figs., 14 refs. 1950.

The only known intermediate host of *Oxyspirura mansoni*, a nematode parasite found beneath the nictitating membrane and in the conjunctival sac of fowls and a number of other birds, is *Pycnoscelus surinamensis* (L.), and observations in Hawaii on the bionomics of this cockroach are described in the first part of this series. It is widespread in the Hawaiian Islands and normally lives in loose, sandy soil or beneath débris. Both nymphs and adults are most abundant in or around fowl batteries and yards, where they feed mainly on the droppings of the fowls and other organic matter. The adults and large nymphs remain hidden in the soil during daylight, but the very young nymphs are positively phototropic. In random collections of adults, females were always more abundant than males. Observations on a large number of females kept individually and examined several times a day and others made in the normal habitat of the cockroach showed that the female forms an oötheca about the eggs but normally retains it in its body until the nymphs have hatched. Deposition of the oötheca was sometimes induced by exciting a female, but no eggs are known to have hatched under these circumstances. The birth of the nymphs is described. Broods in the laboratory varied in size from 30 to 36 nymphs.

The results of a study of the life-history of *O. mansoni* are given in the second part. Both it and the cockroach are circumtropical in distribution, and neither is known to occur in Hawaii at altitudes exceeding 3,000 ft. As almost all individuals of *P. surinamensis* collected from soil beneath fowl houses and in poultry yards were infested with it, only laboratory-reared nymphs were used in experiments. They were fed on wholemeal bread and water, and when needed for experimental infestation were isolated without food or water for at least 48 hours. They were then offered living female worms or bread soaked in water containing embryonated eggs obtained by macerating gravid worms taken from the eyes of fowls. They ate both readily. An account is given of the methods of examining the cockroaches for infestation.

The eggs, larval worms of all four stages and adults are described, and a list is given of the birds in which the adults have been found. Examination of *P. surinamensis* from different areas showed that although wild birds become infested with the worms, they do not serve as a source of infestation to the cockroaches, presumably because their faeces are too scattered. The eggs of the nematode are laid in the eyes of the bird and are washed down the naso-lacrimal ducts with the eye fluid into the mouth, swallowed and passed out with the excrement. The cockroach becomes infested by eating embryonated eggs or first-stage larvae in the droppings of infested birds. Development in it, which lasts about 51 days, is described in detail. Some first-stage larvae had passed from the midgut to the body cavity by the eighth day, and many by the tenth day. Second-stage larvae were observed on the 25th day. In this stage, they became encysted on the alimentary tract. Moulting apparently took place after 45–50 days, and numerous third-stage larvae were found on the 51st day, some encysted but most wandering freely in the body cavity. On reaching the third stage, the larvae become infective to the definitive host, to which they gain access through the ingestion of the cockroach. They seldom pass farther than the crop of the bird, where they migrate from the tissues of the cockroach under stimulation of the heat and moisture. They then crawl up the oesophagus, reach the roof of the mouth and enter the eyes through the naso-lacrimal ducts. Worms were observed in the eyes of a fowl within five minutes of the ingestion of an infected cockroach or of introduction of infective worms into the mouth by pipette. Fourth-stage larvae were present in the eyes after 5–7 days and adults after about three weeks, and embryonated eggs were first seen in the crop contents on the 32nd day.

The experiments described in the third part were designed to show the percentage survival of ingested infective larvae, the reactions of previously uninfested birds to an initial introduction of infective larvae, and the symptoms and pathology evident in uncomplicated infestations. Experimentally induced infections caused temporary discomfort and some histopathologic changes but no advanced ocular pathology or blindness, probably because of the absence of secondary infections. The largest number of worms that can be accommodated in the eyes of a single fowl appeared to be about 200.

The methods of control discussed in the fourth part include direct attack by mechanical or chemical removal of the adults from the eye or by rendering the eye unsuitable for the parasites by nictitectomy, and indirect attack through control of the cockroach. The latter appears to be the most practical and economical approach. In Hawaii, fowls are reared in batteries on wire above the ground. Suggested mechanical measures are placing the legs of batteries in cans of oil to prevent cockroaches from gaining access to the battery cages, and removing accumulated manure, rubbish and loose top soil from beneath batteries. In the autumn of 1948, when manure was allowed to accumulate under batteries at a poultry farm, a trowelful of soil yielded 30 cockroaches or more. In May 1949, after loose top soil and manure had been removed frequently for about six months, only two adults and one nymph were found on the whole farm in 15 minutes. The prospects for biological control are not encouraging. Several local birds and the toad, *Bufo marinus* [*cf. R.A.E.*, B **31** 33], prey on *P. surinamensis*, but they are evidently unable to control it effectively. Ants are probably the chief insect enemies, and a number of cockroaches died in the laboratory apparently as a result of infestation by mites. In experiments, the Sphegid, *Ampulex compressa* (F.), which was introduced into Hawaii against other cockroaches [**31** 81], failed to parasitise *P. surinamensis*.

For chemical control, carbon bisulphide and diesel oil have been used with varying degrees of success. Preliminary trials have indicated that weekly dusting with 1 per cent. γ benzene hexachloride or spraying with 1 per cent. chlordan or 1 per cent. DDT in kerosene would materially reduce the

cockroach population on a farm [*cf.* **40** 36], and combined with removal of manure should virtually eradicate it. Most other manure-inhabiting insects would probably be controlled as well, and floor-brooding of chicks [*cf.* **40** 200] might become practicable. In an examination of the survival time of the infective *Oxyspirura* larvae in dead cockroaches kept under normal weather conditions, living larvae were found after 96 but not 108 hours in cockroaches killed by decapitation, after 24 hours in those killed by chlordan, and after 48–72 hours in those killed by other common insecticides.

Kettle (D. S.) & Lawson (J. W. H.). **The early Stages of British Biting Midges *Culicoides* Latreille (Diptera : Ceratopogonidae) and allied Genera.**—*Bull. ent. Res.* **43** pt. 3 pp. 421–467, 6 pls., 123 figs., 20 refs. London, 1952.

Pupae of 29 British species of *Culicoides* and larvae of 28 of them and larvae and pupae of the genera *Stilobezzia* and *Serromyia* and the subgenera *Ceratopogon* and *Isohelea* of *Ceratopogon* are described, and keys are given to all the larvae and all but one of the pupae. Photographs of the fourth-instar larvae and figures of the so-called "hypopharynx" (the true epipharynx) of most of the larvae are given, together with figures of specific characters of the pupae. The number of larvae of each species of *Culicoides* found in an examination of habitats of six types and the percentages in the different habitats are shown in a table. The species could be divided into six groups according to larval habitat, namely, those breeding in bog, fresh-water marsh, swamp, mud, salt-water marsh and dung. The vertical distributions of the larvae of seven species of *Culicoides* are given. There were marked differences between the species in this respect.

Davies (L.). **The Hatching Mechanism of Muscid Eggs (Diptera).**—*J. exp. Biol.* **27** no. 3–4 pp. 437–445, 3 figs, 8 refs. London, 1950.

The following is based on the author's introduction and summary. The hatching of eggs in many insects, particularly Muscoid flies, is markedly affected by humidity, and W. M. Davies & Hobson [*R.A.E.*. B **23** 227] observed that the eggs of *Lucilia sericata* (Mg.) that had been incubated under moist conditions and would normally have hatched in a few minutes completely failed to do so when transferred to a relative humidity of 50 per cent. [*cf.* also **38** 122]. It has been assumed that delay or prevention of hatching by low humidity is largely a result of hardening of the chorion under dry conditions. The observations here described were designed to elucidate the mode of action of humidity on the hatching of Muscoid eggs ; eggs of blowflies of seven species in three genera were used and the results given apply to all of them. It was shown that the eggs change their shape almost simultaneously with changes in the relative humidity of the air in their immediate vicinity. Evidence is produced that these changes of shape are brought about by the effect of humidity on the chorion. They appear to set up increasing strain in the chorion with increasing humidity, making it progressively easier for the larvae to rupture the shells.

Jones (B. M.). **The sensory Physiology of the Harvest Mite *Trombicula autumnalis* Shaw.**—*J. exp. Biol.* **27** no. 3–4 pp. 461–494, 24 figs., 22 refs. London, 1950.

The object of the observations described was to discover the responses of larvae of *Trombicula autumnalis* (Shaw) to stimuli that were likely to have value in acquiring a host and to determine the nature of the sensory organs. These organs are described. Most of the following is taken from the author'

summary of the findings regarding responses. In a strong beam of light, the mites moved directly towards the source, whereas in a weak light, their tracks were inclined to be wavy at first but straightened as they approached the source. When offered a linear gradient of light intensity, the mites avoided the darkened part of the field and moved towards the lightest part. Movement towards sunlight was shown to be a response to light and not to heat. A sudden decrease of light intensity produced a questing response, as did passing a shadow over mites in the field.

The sensory perception of heat was poorly developed. Mites kept at 18–19°C. [64·4–66·2°F.] could not locate a young living mouse or a warm tube from a distance of 0·5 cm. On touching either, they responded by accelerated rate of movement. In a linear or concentric gradient from 7 to 40°C. [44·6 to 104°F.], they appeared to prefer a range extending from 15 to 26°C. [59 to 78·8°F.]. They were repelled at a distance of 0·5 cm. by small pads of cotton-wool moistened with phenol, methyl phthalate, dilute ammonia, xylene or a 3 per cent. solution of glacial acetic acid, from which they were separated by a fine lawn screen. Toluene repelled them at 1·5 cm., and a mixture of amyl acetate and water at 5 cm. They were completely indifferent to the odour of mouse skin, mouse liver, mouse, rabbit or human sebum or human or rabbit cerumen, but a pad of cotton-wool moistened with perspiration induced avoiding reactions on contact or near contact.

Depletion of the water content influenced the response of the mites to humidity. A desiccated mite was active in dry air and inactive in moist air, but a normal one would settle in either moist or dry air, though it avoided saturated air. High humidity was needed for prolonged survival [*cf. R.A.E.*, B **40** 178], but free water was avoided. Unfed mites were very sensitive to touch. The extent of stimulation by contact with each other's bodies, which is regarded as high, immobilises them, and it is primarily responsible for the quiescent state of a cluster of mites. When the stimulation is low, as when only the tarsi are in contact with a surface, the mite responds by a high state of activity. Mites immediately began to quest when they were lightly touched or when the substratum vibrated. When relative humidity was above 95 per cent., light induced the mites to climb up a rod and form a cluster at the tip. Tests failed to yield definite indications of negative geotaxis.

The analysis of the sensory perceptions of the mite suggests that its behaviour in the natural environment is a series of simple responses to stimuli that form the complex pattern of the micro-habitat. The chances of finding a host are lessened in dry conditions, when the mites avoid exposed situations and seek moist soil, but a combination of warmth, fluctuating light and high humidity causes them to cluster at high points on soil or vegetation. A single mite seldom remains alone at the highest point of its immediate surroundings, but clusters remain still. Clusters, once formed, will persist after dusk, when small mammals are becoming active. The response to shading or to vibrations is one of preparedness. The intensity of the response to the skin of the host is so strong that it overcomes the attraction of light. After a feeding period of about three days, the engorged mites climb over the surface of the body and then drop to the ground where their further existence depends on the moisture content of the soil. If conditions are favourable, they probably enter the soil at once.

Holway (R. T.), Mitchell (W. A.) & Abdel Aziz Salah. **Studies on the seasonal Prevalence and Dispersal of the Egyptian Housefly. II. The Larvae and their Breeding Areas.**—*Ann. ent. Soc. Amer.* **44** (1951) no. 4 pp. 489–510, 14 figs., 10 refs. Columbus, Ohio, 1952.

This second part of a paper on the house-fly [*Musca domestica vicina* Macq.] in Egypt [*cf. R.A.E.*, B **40** 165] contains an account of observations on the

breeding places and seasonal distribution of the larvae made in four villages in Giza Province in 1948 and 1949. Four distinct types of breeding places, latrine-dumps, compost piles, animal rooms and fuel cakes, are distinguished and described in detail. A fifth miscellaneous category included scattered human faeces or infrequent foci such as fowl pens and building-mud mixtures. The latrine-dumps are areas where human faeces, other organic wastes and often waste water are habitually deposited. They are commonly situated at the edges of canals and ponds. Such dumps are necessary as the wastes are too valuable as fertiliser to be discarded. The compost heaps are formed of soil and animal dung. The animal rooms are rooms in which one or more animals are stalled and are found in most village houses. The fuel cakes are made of buffalo dung and straw dried in the sun and their importance as a source of flies is doubtful. They dry rapidly and it appears that the only larvae that normally have time to mature in them are those that have completed part of their development in the dung before they are made [*cf.* **28** 210 ; **30** 137], while the villagers say that they are infested only where the buffalos have not been given green food.

Seasonal changes in the amount of breeding in the four main types of foci were determined by weekly surveys in 1949. Larvae were found in latrine-dumps least often in February and most often in April and May. In compost piles and animal rooms, they were found most often in June and July and in fuel cakes during the autumn. All types except fuel cakes showed a decline in breeding in August. During the autumn, breeding in latrine-dumps and compost piles showed a moderate increase and breeding in animal rooms decreased steadily. There was a general decline in December-February.

The seasonal variations in breeding frequency are interpreted in terms of environmental factors. The interaction of temperature, adult population density and dispersal, and the high attractiveness of human faeces were found to be most important in determining seasonal activity in latrine-dumps, compost piles and animal rooms. Moisture, as rainfall and relative humidity, appeared to be least important in the case of latrine-dumps and animal rooms but favourable to increased breeding in compost piles and particularly in fuel cakes and scattered human faeces.

Moisture, as household waste water, pump drainage, and pond and canal margins, is a highly important factor in maintaining the breeding potential of latrine-dump areas. Separation of this type of moisture supply from accumulations of organic materials is suggested as a possible means of reducing the breeding potential of latrine-dumps. Daily raking over of the top layers of compost piles to increase evaporation may be useful. Co-ordination of sanitary methods with chemical methods would increase the effectiveness and economy of village control programmes.

Fernando (H. E.), Roan (C. C.) & Kearns (C. W.). **The Penetration, Distribution and Metabolism of organic Phosphates in the American Roach, *Periplaneta americana* (Linn.).**—*Ann. ent. Soc. Amer.* **44** (1951) no. 4 pp. 551–565, 1 fig., 17 refs. Columbus, Ohio, 1952.

In further investigations on the fate of organic phosphates in *Periplaneta americana* (L.) [*cf. R.A.E.*, B **39** 1], radioactive TEPP (tetraethyl pyrophosphate), diethyl phosphoric acid, tetra-n-butyl pyrophosphate, paraoxon (diethyl p-nitrophenyl phosphate) and parathion were dissolved in acetone and administered to adults of both sexes by topical application to the cervical membrane or by mouth with a microsyringe. Quantitative data on the concentrations of the compounds in the tissues and blood after various periods were obtained by assay with a counter, and radioautographs were used to study the gross distribution of TEPP after topical application. The method of preparing them, which is suitable for use with compounds soluble in water and

in the organic solvents used in the preparation of tissues for microtomy, is described.

The radioautographs showed that the heaviest concentration of TEPP was in the crop and that lower ones were present in the midgut and gastric caeca. Vague traces were detected in the fat-body, muscles and hindgut, but none in the ovaries or thoracic or cerebral ganglia, and it is concluded that the crop selectively concentrates most of the TEPP from the blood, the passage of the compound down the alimentary canal being very slow. The Malpighian tubes did not take up any appreciable quantity from the blood, and the amount entering the central nervous system was too small to cause a perceptible darkening of the film used.

The assays with the counter showed that the blood is the chief medium of transmission of all the compounds in the body. Topically applied paraoxon penetrated extremely rapidly, 51 and 92 per cent. of the dose of 5 mmg. having entered the insect after 10 and about 30 minutes, respectively ; concentration by the crop was rapid and selective, and the amount entering the central nervous system was small (0·025 mmg. after 30 minutes), but probably much more than that required for cholinesterase inhibition. Parathion was much slower in penetration and distribution ; the concentration was greatest in the crop, but much lower than for paraoxon, and the rate of accumulation in the central nervous system was very slow indeed (0·017 mmg. after 4 hours) ; this may explain the slower action of parathion. Diethyl phosphoric acid and tetra-n-butyl pyrophosphate, which are not toxic to *P. americana*, and TEPP all followed the same general pattern of distribution as parathion and paraoxon. Diethyl phosphoric acid entered the central nervous system in about the same amounts as the other compounds, and this throws doubt on theories that it is responsible for the action of phosphate esters on enzyme systems [*cf.* A **37**, 214]. Studies *in vitro* showed that diethyl phosphoric acid did not inhibit cholinesterase.

Doses of 40 mmg. TEPP can be administered orally without the appearance of any toxic symptoms in over 95 per cent. of the cockroaches, whereas doses of 5 mmg. parathion or paraoxon evoke toxic symptoms as rapidly as a topically administered dose of the same size. All three compounds showed a progressive decrease in concentration in the crop and a gradual increase in the midgut and hindgut, but TEPP entered the blood stream more slowly than the others, and the radioactive material in the blood of a cockroach treated orally with TEPP did not inhibit cholinesterase and had probably been metabolised to diethyl phosphoric acid. The rapid diffusion of parathion and paraoxon from the crop resulted in lethal accumulations in the vulnerable tissues before any detoxifying mechanism could operate. An average of only 0·0006 mmg. of the 0·025–0·03 mmg. paraoxon that has entered the central nervous system by the knockdown time after topical application is apparently used in the inhibition of cholinesterase. Further tests showed that the inhibitory activity of TEPP was not lost in either the blood or the foregut. Water extracts of excreta from insects that received sublethal topical applications of TEPP failed to inhibit rat-brain cholinesterase, so that the decomposition of TEPP probably occurs after it leaves the foregut and before it is voided with the excreta. Similar tests with insects that had ingested TEPP 24 hours previously showed that material in the gut inhibited cholinesterase, whereas that in the blood did not.

RIEMSCHNEIDER (R.). **Ein Beitrag zur Toxikologie kontakt-insektizider Substanzen.** [A Contribution to the Toxicology of contact-insecticidal Substances.]—*Anz. Schädlingsk.* **22** pt. 1 pp. 1–3, 18 refs. Berlin, 1949.

Contact insecticides consisting of halogenated hydrocarbons or phosphoric-acid esters do not show the same order of relative toxicity to mammals as to

insects, and an account is given of laboratory investigations of the acute and chronic toxicity of some of them to rats. For acute toxicity, they were administered orally in olive oil. The median lethal dosages in mg. per kg. body-weight were 10–12·5 for E 605 (parathion), 175 for M 414 (octachloro-endomethylene-trimethylcyclohexane), 200 for M 410 (chlordan), 200 for p,p′fluoro-DDT (DFDT), 225 for p,p′DDT, 225 for γ BHC (γ benzene hexa-chloride), 750 for δ BHC, 1,000 for o,p′fluoro-DDT, 1,250 for o,p′DDT, 1,500 for α BHC and 1,750 for p,p′DDD (α, α-bis(4-chlorophenyl)-β, β-dichloroethane). E 605 was the most rapid in effect, the first reaction to the poison appearing within an hour and death occurring in 15–25 hours. Mortality for β BHC at 2,000 mg. per kg. was less than 10 per cent., and 100 mg. ε BHC administered to a single rat weighing 150 gm. caused no symptoms of poisoning.

In the tests of chronic toxicity, M 410, p,p′DDT and E 605 were administered daily to rats at rates of 1, 5 and 10 mg. per kg. bodyweight. M 410 and DDT had no effect in 75 days, but rats given E 605 at the two lower rates died after 4–8 and 2–5 days, respectively. When small amounts of M 410 or p,p′DDT were included in the diet of the rats and their organs examined after a year, evidence of the accumulation of the poisons was found in those given 0·4 gm. per kg. food, but not in those given 0·25 gm.

Riemschneider (R.) & Schölzel (E.). **Literatur zur HCH- und Diën-Gruppe. Liste III. Abgeschlossen im wesentlichen 1. Juli 1950.** [Literature on the Benzene-hexachloride and Diene Group. List III. Closed mainly 1st July 1950.]—128 pp. Berlin, P. Parey, 1952.

This list is the third of a series of which the first two were circulated in manuscript. It is being published concurrently in the *Zeitschrift für angewandte Entomologie* in three parts (**33** pts. 3–4, **34** pt. 1) and comprises a bibliography of well over 2,000 works published up to 1st July 1950 on insecticides of the benzene-hexachloride and diene groups. The term diene group includes not only compounds produced by diene synthesis, such as chlordan, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethano-naphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], but also, for convenience, those, such as toxaphene, obtained by direct halogenation of terpenes. The entries for each paper comprise the full title and bibliographical reference, references to abstracts if available, and indications of the group or groups of insecticides concerned, with the DDT and E (phosphorus) groups included when they are also dealt with, and the main aspects treated (chemical, physical or biological).

Wilson (S. G.). **An experimental Study of East Coast Fever in Uganda. I. A Study of the Type of East Coast Fever Reactions produced when the Number of infected Ticks is controlled.**—*Parasitology* **40** no. 3–4 pp. 195–209, 24 graphs, 11 refs. London, 1950. **II. The Durability of Immunity in East Coast Fever.**—*T. c.* pp. 210–214, 1 fig., 4 graphs, 6 refs.

African or East Coast fever, a disease of cattle caused by *Theileria parva*, has been recognised in Uganda for more than 40 years. The mortality it causes in endemic areas is very variable and the reason for this is not clear. The experiments described in the first paper were carried out to ascertain whether the number of infected ticks (*Rhipicephalus appendiculatus* Neum.) engorging simultaneously on susceptible animals influenced the course of the disease [*cf. R.A.E.*, B **30** 57, etc.]. The ages of the animals used varied from 5 to 35 months, but other conditions were fairly uniform. When ten were grazed in a one-acre paddock where the number of infected ticks was high, eight died of acute East Coast fever, and the other two showed mild reactions. In a second experiment, 15 susceptible animals and two immune ones were grazed

in the same paddock. To give the susceptible animals some protection from the bites of infected ticks, the ears of nine were sprayed with DDT and those of three with BHC (benzene hexachloride). The effect of the treatment on infestation by the ticks has already been noticed [**36** 206]. All the susceptible animals became infected with *T. parva*, and the two that were lightly sprayed once only with DDT reacted strongly and one of them fatally. The onset of symptoms in four that were more thoroughly treated with DDT was delayed but the oldest one (26 months) died. The other nine were brought into the experiment later, when tick counts were already low. Two died from acute infection with *T. parva* and one from subacute infection complicated with a helminth infestation. The types of reaction in the group were varied. In the third and fourth experiments, susceptible animals grazed in the same tick-infested paddock after the number of infected ticks had been further reduced all showed mild non-fatal reactions.

When susceptible animals exposed to tick infection in an endemic area were treated with BHC by mouth, considerable protection was afforded against ticks and other ectoparasites [**37** 58] and the severity of reactions to East Coast fever depended on the control of ticks. When known numbers of locally infected ticks were fed on susceptible calves, simultaneous feeding by three or four ticks resulted in fatal infection, but one or two ticks provoked no reaction. In a small experiment with ticks infected with a strain of *T. parva* from Kabete in Kenya, three ticks caused only a mild reaction and one or two again caused none. Indications in one experiment that animals two years old or more reacted more severely than younger ones were not borne out by the results of other experiments. It appears likely that age does not influence decisively the course of the reaction if the tick infestation is heavy.

The following is substantially the author's summary of the second paper. Confusion exists as to whether the immunity produced by one attack of East Coast fever is absolute or whether it requires to be maintained by reinfection. During the present experiments, five of six calves that had recovered from mild infections were again attacked by the disease after reinfestation by infected ticks. The interval between the attacks varied from 1 to 16 months, and it is suggested that when the interval is prolonged the second attack will be severe and possibly fatal. It is concluded that the durability of the immunity depends on the severity of the original attack. The temperature reaction is the best indicator of the severity of the attack and the type of immunity.

HAFEZ (M.). **On the Behaviour and sensory Physiology of the House-fly Larva, *Musca domestica* L. I. Feeding Stage.**—*Parasitology* **40** no. 3–4 pp. 215–236, 28 figs., 49 refs. London, 1950.

The following is based mainly on the author's summary. The reactions of third-instar larvae of *Musca domestica* L. to humidity, temperature and scent and the orientation mechanisms involved were studied in a circular arena that had a floor of bolting silk stretched over perforated zinc and was placed over tanks of water differing in temperature or over pieces of blotting paper soaked in solutions that controlled humidity or provided scent in such a way that the stimulus was different in degree or kind in each half of the circle. The reactions of the larvae to various combinations of the factors and light were also tested.

The larvae were least sensitive or even indifferent to differences in humidity at relative humidities lower than 50 per cent. Above this range, they avoided dry air, and a difference of 5 per cent. within the range 90—100 per cent. humidity ensured complete avoidance of the drier side by nearly all individuals. They generally showed no adaptation to the humidity to which they had previously been exposed. Their behaviour was more closely correlated with relative humidity than with saturation deficiency. This suggests that the

receptors act hygroscopically. The receptors are probably three pairs of sense organs on the ventral surface of the thorax, each bearing three minute hairs.

The rate of movement of the larvae was directly proportional to temperature between 10 and 40°C. [50 and 104°F.]. When offered a choice between 25°C. [77°F.] and another temperature, they avoided 37°C. [98·6°F.] or over in saturated air and 33°C. [91·4°F.] or over in dry air. When in contact with water, they did not avoid 40°C. but avoided 42°C. [107·6°F.] or over. They markedly avoided 10°C. or under at any humidity. They were least responsive to differences of temperature between 25 and 30°C. [77 and 86°F.] in dry air, 25 and 33°C. in moist air, 25 and 39°C. [102·2°F.] in moist air with contact water, and generally between 25 and 15°C. [59°F.]. They showed no adaptation to a temperature to which they had previously been exposed. There was no evidence of a localised temperature receptor. Decapitated larvae avoided high temperatures as strongly as normal ones.

The larvae were attracted by the scents of pig-dung, horse-dung and milk, and preferred them in the order given. They were also attracted by ammonia, acetone, trimethylamine and ethylamine and were repelled by acetic, formic, propionic and butyric acids.

In experiments on their responses to 20 combinations of temperature, humidity, scent and light, their behaviour was dominated by temperature and humidity and was least influenced by scent and light, to either of which they quickly became adapted.

The orientation of the larva is mainly achieved by the operation of klinokinesis and klinotaxis. Klinokinesis involves an increase in the frequency of random turning movements and is usually displayed as the larva enters a mildly unfavourable zone of stimulation. Klinotaxis is a mechanism of directed orientation involving the comparison of two intensities of stimulation at successive times and usually operates when the larva meets a steep gradient between the favourable and adverse zones. In the response to low humidity or high temperature, a further mechanism involving an increase in the rate of movement (orthokinesis) comes into action. Sensory adaptation, evident in a steady decline of the increased rate of change of direction after prolonged exposure to the adverse condition, makes klinokinesis a mechanism of preference. By the operation of these mechanisms, the larva is usually kept out of zones of adverse stimulation. The bearing of the reactions noted on the habits of the larva in its normal environment is also discussed.

Jones (B. M.). **The Penetration of the Host Tissue by the Harvest Mite, *Trombicula autumnalis* Shaw.**—*Parasitology* **40** no. 3–4 pp. 247–260, 10 figs., 20 refs. London, 1950.

The life-cycle and general method of feeding of Trombiculid mites are briefly outlined, and the organs concerned in piercing and sucking by the larva of *Trombicula autumnalis* (Shaw) are described in detail. The choice of habitat on the host is influenced by the physical characters of the skin, notably the amount of hair and exudation, and the inside of the ear and area around the anus are characteristic habitats on most mammals. On man, a warm, moist site where the skin is thin, is sought, and the waistline, axillae, genitals, groin and ankle are typical sites of attachment. The food of the larvae consists of tissue fluid and disintegrated cells of the malpighian layer partly liquified by the action of injected saliva. The mechanism of the initial piercing of the skin by the cheliceral claws and the mechanism of suction are described. During feeding, which lasts 3–5 days, intermittent injections of saliva are responsible for the formation of a tubular tissue canal in the skin of the host [*cf. R.A.E.*, B **18** 125], and superimposed layers of keratinised protective tissue are deposited around its insoluble wall. The tissue canal serves as a duct for both the ejection of saliva and the suction of food, which are alternating

processes. The relationship between the intermittent injections of saliva, the formation of the tissue canal and the deposition of protective tissue is discussed and explained.

MACAN (T. T.). **Malaria Survey of the Arakan Region of Bengal and Burma.**—*Parasitology* **40** no. 3–4 pp. 290–297, 2 figs., 3 refs. London, 1950.

The area studied was a strip of land between the sea and the top of the first mountain range on the east side of the Bay of Bengal and included part of Bengal and part of the Arakan district of Burma. It comprised a forested uninhabited mountain region, a region of low hillocks interspersed with marshy bottoms, some of which had been drained, cleared and cultivated, and a flat coastal plain partly protected from the sea by a wall that leaked in many places. Rain fell from early June till early October, and the rest of the year was mainly dry. Little is known about the mountain region, but larvae of *Anopheles maculatus* Theo., *A. minimus* Theo., *A. barbirostris* Wulp and *A. aitkeni* James were found there in April 1944, when most potential breeding-places were dry, and 73 adults of *A. minimus* Theo., one of which contained malaria sporozoites, and two adults of *A. maculatus* were taken in a tent at night.

Malaria was intense locally in the hillocks and coastal plain region, but was unevenly distributed. There was evidence of active transmission in March and April, again during the rains, and in October. There was a lull in May and June, but any other lulls there may have been were not discovered, since observations could not be made throughout the year. The results of collections of larvae made from March to June and of adults made in April, May, October and November are given. Observations on adults at night revealed *A. leucosphyrus*, Dön., *A. jeyporiensis* James and *A. minimus* near man and rarely near cattle. *A. sundaicus* (Rdnw.), *A. philippinensis* Ludl., *A. annularis* Wulp and *A. hyrcanus* (Pall.) attacked both man and cattle, though some at least attacked man only in the absence of cattle. *A. aconitus* Dön., *A. subpictus* Grassi, *A. vagus* Dön., *A. barbirostris* and *A. jamesi* Theo. were feeding mainly or entirely on cattle, though females of *A. aconitus* containing old blood were found in tents at night, having presumably entered them for shelter. The species found resting in houses by day were those that were biting cattle by night, whereas the man-biters mainly sought shelter out of doors, so that searching for mosquitos in houses early in the morning would give very misleading results.

Few dissections were made, and sporozoites were found only in two females (1·6 per cent.) of *A. jeyporiensis*, which was thought to be responsible for most of the malaria transmitted early in the year. The night catches suggested that *A. jeyporiensis*, *A. minimus*, *A. leucosphyrus* and probably *A. sundaicus* are important vectors, that *A. philippinensis* must be suspected and that *A. hyrcanus* and *A. annularis* may be important locally under war conditions. *A. minimus*, *A. jeyporiensis*, *A. philippinensis* and *A. sundaicus* did not attack until several hours after nightfall, and whereas *A. minimus* entered houses, *A. philippinensis*, when it was not raining, preferred to attack persons sleeping out of doors. *A. sundaicus*, if prevented from feeding during the night by protective clothing, attacked after sunrise.

RADFORD (C. D.). **The Mites (Acarina) parasitic on Mammals, Birds and Reptiles.**—*Parasitology* **40** no. 3–4 pp. 366–394, 5 pp. refs. London, 1950.

This paper comprises a list of the species of mites (excluding Trombiculids and Analgesids) belonging to genera that parasitise mammals, birds or reptiles,

showing the host in nearly all cases, and also a list of hosts giving their popular names. Both lists are arranged in systematic order.

[Aristovskiĭ (V. M.), Ragoza (N. I.), Smirnov (G. G.) & Shtakel'berg (A. A.).] **Аристовский (В. М.), Рагоза (Н. И.), Смирнов (Г. Г.) и Штакельберг (А. А.).** Ed. **Epidemiological and parasitological Expeditions to Iran and parasitological Investigations.** [*In Russian.*]—$10\frac{1}{2} \times 6\frac{1}{2}$ ins., 376 pp., frontis., 91 figs., 1 fldg. table, many refs. Moscow, Akad. Nauk SSSR, 1948. Price 33 *rub.*

The first part of this work (pp. 7–252) comprises reports of the results of three expeditions to north-eastern, central and south-western Persia made by scientific workers from the Soviet Union to study the conditions associated with epidemics of various diseases. All three were made between December 1941 and April 1943 and covered a total period of seven months. The second part (pp. 253–374) is devoted to accounts of investigations in the Soviet Union on parasitology of medical or veterinary importance. The papers concerned with arthropods and diseases transmitted by them are noticed below.

[Pavlovskiĭ (E. N.).] **Павловский (Е. Н.). Tick-borne Relapsing Fever in Iran** (pp. 179–202). The literature on tick-borne relapsing fever in Persia [*cf. R.A.E.*, B **24** 174 ; **27** 150 ; **36** 71] is briefly reviewed, and the nomenclature of the tick [*Ornithodoros tholozani* (Lab. & Mégn.) (*papillipes* (Bir.)] that is the sole or principal vector, is discussed. The author retains the name *papillipes* for it as it differs in certain characters from descriptions and figures of *tholozani* and he cannot settle the identity of the latter without examination of the type. [The type was, however, examined by Desportes and Campana (**38** 178), who found that *papillipes* is a synonym of *tholozani* and that *tholozani* is represented by the typical form in Persia and by a variety that they named *pavlovskyi* in Soviet Central Asia.]

Examples of this tick were collected in various parts of Persia, and the occurrence of spirochaetes in several batches from different localities was demonstrated by the infection of guineapigs on which they were fed. It was widely distributed and occurred chiefly in animal quarters sheltering under plaster and in cracks in the walls, or in dry refuse on the floor and in mangers. It was also found in the walls of a ruined building and in a cave ; the cave was examined because a group of 17 people who had spent the night in it were bitten by ticks and all developed relapsing fever 6–9 days later. The tick was present in winter in animal quarters in which the temperatures ranged from 8 to 22°C. [46·4–71·6°F.], it transmitted relapsing fever in the laboratory at 5°C. [41°F.], and infection in man in north-eastern Persia was acquired at all seasons of the year, even in January. Notes are given on the symptoms in relapsing-fever patients in this part of the country ; many of them had sheltered in ruins or other places where ticks were likely to have been present, and about 33 per cent. had a history of tick-bites.

The other species of *Ornithodoros* found were *O. lahorensis* Neum. and *O. canestrinii* (Bir.). *O. lahorensis* was the most common and widely distributed species, and the only one found on cattle, sheep, goats and camels, on which it was very abundant, but it has previously been shown that it does not transmit tick-borne relapsing fever [*cf.* **27** 150 ; **34** 205, etc.]. *O. canestrinii* was found in a number of places in quarters occupied by sheep or cattle, and was particularly abundant in cracks among the stones of the walls of a disused enclosure for sheep in a completely bare site exposed to the sun, which indicated its ability to survive under very unfavourable conditions. No infection in guineapigs resulted from the feeding of adults tested for natural infection after collection, of adults fed 1–5 months previously on infected guineapigs, or of second-stage nymphs fed as larvae on infected rabbits over 13 months before [*cf.* also **25** 25].

[Gutzevich (A. V.).] **Гуцевич (А. В.). Mosquitos and Malaria in Iran** (pp. 209–234). The author reviews the scanty literature on the incidence of malaria in Persia [*cf.* **24** 163 ; **40** 71], and quote figures showing that the disease is particularly common in the Caspian provinces, Khuzistan, the western mountainous area and the central plateau, *Plasmodium vivax* being responsible for most of it in the north. Surveys were made in May-July 1942 and between December 1942 and March 1943. A table is given showing the 41 species of mosquitos (including 14 species of *Anopheles*) that occur in Persia or adjoining territories, and the 22 species (of which the seven species of *Anopheles* have already been noticed [*cf.* **33** 16]) that were taken in northern Persia (the Caspian provinces and the central plateau) in 1942, and other tables show the numbers taken at individual places in these areas and in Khuzistan. The distribution of the species of *Anopheles*, their epidemiological importance, and their breeding places are discussed, with notes on the distribution and relative abundance of the mosquitos of other genera.

The severest malaria was found in the Caspian provinces, 20–50 per cent. of the population being affected. Up to 90 per cent. of fresh cases occurred in July–November, with a peak in August. The chief vectors were *A. maculipennis* Mg. var. *sacharovi* Favr, which predominated in the coastal plain, and *A. m. subalpinus* Hackett & Lewis. Small numbers of *A. m. typicus* were also present. Breeding occurred in rice-fields and water connected with irrigation, and to a less extent in the rivers, which become shallow and sluggish in summer. *A. hyrcanus* (Pall.) bred in rivers and natural swamps and possibly played some part in transmission.

The Province of Khuzistan, in the south-west, was the next most malarious area, 15–45 per cent. of the population being affected. The chief vectors were *A. superpictus* Grassi in the north and *A. stephensi* List. in the south. The former bred in rivers and streams and the latter in irrigation ditches and swamps. The other Anophelines found there were *A. pulcherrimus* Theo. and *A. hyrcanus*. In the mountainous regions of western Persia, 15–40 per cent. of the population were infected. *A. superpictus* was apparently the chief vector, though *A. maculipennis* also occurs there. The central plateau, with only from 5 to 20 per cent. infection, was the area least affected. The most important vectors were *A. superpictus* and *A. maculipennis*, which often occurred together, though the former was chiefly associated with the mountainous districts and the second with valleys and table-lands.

In June 1942, a consignment of *Gambusia* was sent by aeroplane from Turkmenistan to northern Persia, and the fish were liberated in artificial reservoirs in various districts. Observations during the following winter and spring showed that they had become established and increased in numbers. *Gambusia* already occurs in many rivers in the province of Ghilan in the north-west, where it has become an important factor in the decrease of malaria in recent years.

[Pervomaĭskiĭ (G. S.).] **Первомайский (Г. С.). Contribution to the Fauna of Sandflies of northern Iran** (pp. 239–248). Notes are given on the local distribution of the species of *Phlebotomus* taken in the Caspian lowlands and the desert-steppe zone in north-eastern and northern Persia during May–July 1942. Ten species were taken in the desert-steppe, and five of them in the humid Caspian zone. Nearly 98 per cent. of the sandflies in the Caspian lowlands were *P. papatasi* (Scop.), and this species and *P. caucasicus* Marz., represented 87 and 5·3 per cent., respectively, of those in the desert steppe. Sandflies were troublesome pests in the whole area, and particularly so in the desert-steppe ; they were most abundant in houses of the European type, and more abundant in native dwellings than anywhere else. Sandfly fever occurs in most of the inhabited areas, and the moist form of cutaneous leishmaniasis is endemic in the district of Teheran. It is believed that *P. papatasi* transmits cutaneous

leishmaniasis as well as sandfly fever, though *P. caucasicus* is a known vector of the former.

[Pervomaĭskiĭ (G. S.).] **Первомайский (Г. С.). Dermal Leishmaniasis and the Pappataci Fever in Iran** (pp. 249–252). Data in the literature, hospital records and personal observations show that cutaneous leishmaniasis is common in the zone of dry subtropical climate in Persia, and that the towns of Teheran, Meshed and Isfahan, with adjoining villages, are important foci. As a rule, the dry chronic form predominates in towns and the moist necrotic form in the Province of Semnan [*cf.* **34** 207 ; **35** 167]. Focal occurrence of the disease has not been proved for the Caspian zone, and the cases recorded may have been contracted elsewhere.

Similar data on sandfly fever indicate that outbreaks begin in May, gradually increase to a peak in late July or early August and decline sharply in September [*cf.* **23** 87].

[Pavlovskiĭ (E. N.) & Skruinnik (A. N.).] **Павловский (Е. Н.) и Скрынник (А. Н.). Transovarian Transmission of Spirochaetes of the Tick-borne Relapsing Fever in the Ticks** *Ornithodorus papillipes* (pp. 255–264). Details are given of the results of laboratory experiments carried out during 1935–43 with the offspring of 41 batches of females of *O. tholozani* (*papillipes*) from various places in Soviet Central Asia, eight batches of *O. verrucosus* Olen., Zas. & Fen. from the Caucasus, and one batch of a species of the group of *O. tartakovskyi* Olenev from south-western Kazakhstan. All the batches were naturally infected with spirochaetes of relapsing fever, except one, which was infected artificially. Large numbers of the F_1 larvae, nymphs and adults were fed on guineapigs, but transmission of spirochaetes to them was effected only by *O. tholozani* [*cf.* **33** 197, 198 ; **34** 206] and only by the offspring of 15 of the naturally infected batches of this species. It was effected by all stages tested (larvae, nymphs of the first four stages and adults from third-stage nymphs), but was seldom effected by larvae. After this paper was written (in 1943), transmission by F_2 larvae and first-stage nymphs was obtained, the spirochaetes having persisted in the successive generations of the tick for seven years.

[Skruinnik (A. N.).] **Скрынник (А. Н.). The Ability to starve in** *Ornithodorus papillipes* (pp. 265–274). A detailed account is given of laboratory observations on the resistance to starvation of different stages of *O. tholozani* (*papillipes*), and the effect of starvation on the duration of the different stages of development. The work began in Leningrad in March 1940, when six batches of ticks all collected in Tadzhikistan in 1936–37 were available. They consisted of varying numbers of males, females and nymphs, and the dates on which they had last fed in the laboratory ranged from November 1936 to January 1940. They were kept in flasks containing filter paper at temperatures ranging from 12°C. [53·6°F.] in winter to 22°C. [71·6°F.] in summer, and the paper was moistened at intervals. In September 1941, the ticks were despatched to Samarkand, where they arrived in October 1942 [*cf.* **33** 165] and were kept in unheated premises in which the temperature varied from 1°C. [33·8°F.] in February to 35°C. [95°F.] in July. They were examined at intervals up to November 1943 and the survivors noted ; the results are shown in a table and discussed. Survival was variable, but in the batch that had been the longest without food (having last fed on 15th November 1936), which had consisted in March 1940 of 12 males, 10 females and 17 nymphs, two of the females and three of the nymphs were still living on the latest date. It is stated in a supplementary note that two nymphs in another batch that had last fed in 1936 were still alive in March 1946. In some of the other lots, nymphs moulted to the adult stage. Total mortality up to November 1943 was 89, 88 and 60 per cent. for males, females and nymphs, respectively.

In further observations, larvae easily survived without food for 3–4 months and one example did so for 15 ; nymphs in the first, second and third stages

survived unfed for up to 18, 30 and 41 months, respectively. Starving ticks remained quiescent, but when disturbed they became as active as those that had fed. After remaining without food for 3–4 years, they engorged, though somewhat more slowly than ticks that were fed once a year, and females that had not fed for three years laid viable eggs. Records of the duration of individual stages in different batches of ticks that were allowed to feed occasionally showed that development from egg to adult may last 10–15 years, and as adults lived for some 6–7 years, the total life might equal 16–22 years. It is probably almost as long under natural conditions [*cf.* **33** 165, 187]. Naturally infected ticks did not lose their ability to transmit spirochaetes as a result of the prolonged intervals between meals, so that foci of relapsing fever may persist for long periods.

Field-collected examples of *O. verrucosus*, *O. lahorensis* and *Argas persicus* (Oken) resisted starvation for about three years and some females of *O. lahorensis* laid some viable eggs after doing so.

[Dubinin (V. B.).] **Дубинин (В. Б.). Ixodid Ticks of the Steppes of south-eastern Transbaikalia and their epidemiological Importance** (pp. 275–286).

A survey for Ixodid ticks was carried out in May–October 1943 in the Dauriya steppe, in the Province of Chita (Transbaïkalia), and information on *Dermacentor nuttalli* Olen. was also obtained from local veterinary stations. *D. nuttalli* and *Ixodes crenulatus* Koch, which are widely distributed in Transbaïkalia and Mongolia, were common in xerophilous steppe habitats, but *I. crenulatus* was found only on wild animals. Unfed adults of *D. nuttalli* pass the winter in cracks in the soil in dry pastures and occasionally in the burrows of rodents ; a few males overwinter on cattle, and it is thought that some nymphs also overwinter. The adults infest domestic animals in spring and autumn. In spring, infestation became common in mid-April, reached a peak in the second half of May and declined towards the end of June. Camels and horses were more heavily infested than cattle and sheep. The autumn infestation, which began at the end of August, was light. The larvae and nymphs were found on small wild animals and birds from June to November. There is one generation a year, and field and laboratory observations showed that complete development requires 78–150 days, with an average of 81 [*cf.* **34** 72]. Outbreaks of piroplasmosis have been observed in horses in some districts of the steppe in April, May and June, and heavy infestation of young sheep and cattle in spring causes severe dermatitis or death. *D. nuttalli* readily attacks man and cases of spotted fever (tick-typhus) in April–July 1943 are recorded, all having a history of bites by this tick [*cf.* **34** 71]. A strain of rickettsiae was isolated from spontaneously infected adults of *D. nuttalli*, and a serological test with Proteus OX19 indicated that *Marmota sibirica* may act as a reservoir of the infection in the Transbaïkalian steppes.

I. persulcatus persulcatus Schulze and *D. silvarum* Olen., which are associated with forests in the north and north-west of the Transbaïkal region, were sparse in the steppe zone. A few examples were taken near Chita, *I. p. persulcatus* occurring on wild rodents and birds and in two instances on man, and *D. silvarum* on domestic animals. Two females of *Hyalomma dromedarii* Koch were taken on a camel that had arrived from western Mongolia.

[Zhmaeva (Z. M.) & Korshunova (O. S.).] **Жмаева (З. М.) и Коршунова (О. С.). The Preservation of the Virus of the Far-eastern Spotted Typhus Fever in the Tick** *Haemaphysalis concinna* **Koch** (pp. 287–289). The experiments described were carried out with the offspring of adults of *Haemaphysalis concinna* Koch collected in the Maritime Province and a strain of the spotted fever occurring in the Soviet Far East [*cf.* **34** 113 ; **36** 177] that had originally been isolated from man. The ticks were fed as larvae on an infected guineapig and some of them transmitted the disease to healthy guineapigs on which they fed as nymphs and to others on which they fed as adults 11 months after the last moult.

[Korshunova (O. S.) & Arkhina (E. V.).] **Коршунова (О. С.) и Архина (Е. В.). The Study of natural Foci of the Tick-borne Spotted Typhus** (pp. 291–298). Many strains of the agent of the Siberian form of spotted fever (tick typhus) that is transmitted by *Dermacentor nuttalli* [*cf.* **32** 220 ; **34** 71] were isolated in guineapigs. They were obtained by injection of suspensions of adults or nymphs of *D. nuttalli* that had been collected on ground squirrels (*Citellus*) in various places, by the feeding of batches of this tick, and by injection of various organs of naturally infected ground squirrels (*C. eversmanni*) and voles (*Stenocranius* (*Microtus*) *gregalis*). Cross-immunity and Weil-Felix tests indicated that both tick and rodent strains were identical with a strain from man. Strains were also isolated from two batches of fleas taken on voles or in their nests, but though these immunised guineapigs from the human strain, they caused fever in guineapigs that had recovered from the latter.

[Petrishcheva (P. A.).] **Петрищева (П. А.). The Vectors of Japanese Encephalitis, and the Period and Way in which anti-epidemiological Measures should be carried out in Hay-fields** (pp. 299–308). In the Maritime Province of the Soviet Far East, Japanese B encephalitis is associated with hay-fields and is contracted during hay-making in July–August. The main vectors are *Aëdes esoensis* Yam., and *Culex tritaeniorhynchus* Giles [*cf.* **37** 148], which readily attack man and animals, while *Culex bitaeniorhynchus* Giles, which feeds mainly on animals and rarely on man, contributes to the circulation of the virus in nature.

In 1940, larvae of *A. esoensis* were observed in May, in small shallow pools heated by the sun. The adults were present from the end of May till mid-September, and were most numerous and active from about mid-June to mid-August. There is only one generation a year. Larvae of *C. tritaeniorhynchus* and *C. bitaeniorhynchus* were abundant from mid-July to the end of September, and the adults were present from the end of June to October. Their breeding places comprised shallow flood-water near lakes, rivers and streams, stagnant water in old river beds, narrow shallow strips along the banks of lakes, and artificial reservoirs. Exposure to the direct rays of the sun was essential. The breeding places of *C. bitaeniorhynchus* usually contained submerged vegetation, whereas those of *C. tritaeniorhynchus* did not, but larvae of the two species sometimes occurred together.

The adults of the species of *Culex* overwintered among the vegetation in the fields or in turf and mosses, and the eggs of *Aëdes* did so in damp areas that become flooded in spring. The most effective measure against all three species is to scorch the dry meadow vegetation in the second half of March. Anthracene oil is recommended against the larvae, one application between 10th and 25th May being effective against *Aëdes* and 3–4 in July–August against *C. tritaeniorhynchus* and *C. bitaeniorhynchus*. Mowing of hay should be suspended between 1st August and 20th September, the hay-makers' camps should be set up on the driest possible sites, all grass within a radius of some 1,000 ft. should be cut and the mosquitos should be repelled by smoke from bonfires.

[Chagin (K. P.).] **Чагин (К. П.). The Characteristics of the epidemic Outbreak of Autumn (Japanese) Encephalitis in the Maritime Province in 1943 with Reference to the parasitological Factor** (pp. 309–318). Cases of autumn (Japanese B) encephalitis have been recorded in the Maritime Province in each year from 1938 to 1942, but there was an epidemic in 1943 that differed from previous ones in that it began earlier (on 21st August), was more intense, spread over a wider area and had two peaks instead of one. Of the known vectors [*cf.* **37** 146, 148], *Culex tritaeniorhynchus* and *C. bitaeniorhynchus* were numerous in the affected districts, and *Aëdes togoi* (Theo.) and *A. esoensis* occurred in small numbers in a few of them. The adults of the first generation of *C. tritaeniorhynchus* and *C. bitaeniorhynchus* were present from 5th August, and those of the second appeared in numbers in the second half of September. The chief

breeding places were rice-fields and permanent swamps in meadows. Heavy rains at the end of August washed away most of the larvae and pupae from rice-fields, but formed fresh breeding places in low-lying sites, resulting in a wider distribution of these mosquitos and bringing them nearer to inhabited places. *C. tritaeniorhynchus* was the main species responsible for the severity of the epidemic ; it was unusually abundant among the mosquitos collected on man, on horses and in dwellings, and a temporary suspension of its activity by heavy rains and strong wind at the end of August explained the occurrence of the two peaks in the epidemic.

SASA (M.) & SABIN (A. B.). **Ecological Studies on the Mosquitoes of Okayama in Relation to the Epidemiology of Japanese B Encephalitis.**—*Amer. J. Hyg.* **51** no. 1 pp. 21–35, 2 figs., 13 refs. Lancaster, Pa., 1950.

The following is almost entirely based on the authors' summary. The incidence, food preferences and breeding places of various species of mosquitos were studied in the Okayama Prefecture between 7th July and 7th September 1946. Among the 18,324 adults collected in Okayama City in dwellings and animal shelters and by traps baited with man or animals, about 81, 10 and 1·2 per cent. were *Culex tritaeniorhynchus* Giles, *C. pipiens pallens* Coq. and *C. vishnui* Theo., respectively [*cf. R.A.E.*, B **38** 194], whereas among 811 collected in mountain districts in which Japanese B encephalitis is known to occur, these species represented 0, 0·2 and 57 per cent. *Mansonia uniformis* (Theo.), which bites man aggressively, was seen only in the coastal area along Kojima Bay, where it and *C. tritaeniorhynchus* constituted 20 and 65 per cent. of the mosquitos identified. *Anopheles hyrcanus sinensis* Wied. represented about 6, 14 and 4 per cent. of the mosquitos in the three areas.

C. p. pallens fed predominantly on fowls, next on man and in only negligible numbers on domestic mammals. The fact that fowls, which are susceptible, have regularly failed to show evidence of encephalitis suggests that *C. p. pallens* does not transmit the disease under natural conditions. *C. tritaeniorhynchus* was the chief mosquito attracted by domestic mammals and man. However, few females of this species were found engorged with blood after biting man, while nearly all of those found in traps or shelters containing domestic mammals were engorged. *C. tritaeniorhynchus* and *A. h. sinensis* were found during the day resting in the dark and humid corners of the animal shelters in which they had become engorged with blood the night before. This observation suggests that the chain of transmission from the domestic mammals, which are more regularly infected with the virus than is man, might be broken by means of measures designed to kill the engorged mosquitos in the animal shelters.

SABIN (A. B.). **Search for Virus of Japanese B Encephalitis in various Arthropods collected in Japan in 1946–1947.**—*Amer. J. Hyg.* **51** no. 1 pp. 36–62, 4 figs., 23 refs. Lancaster, Pa., 1950.

The following is based on the author's summary. A total of 245 lots of arthropods collected in Japan in 1946 and 1947, including thousands of adult mosquitos and mosquito larvae of different species, as well as hundreds of ticks, fowl mites and lice from horses, cattle and pigs, yielded negative results in tests for the presence of the virus of Japanese B encephalitis. During one stage of the work, many isolations of the virus were obtained in serial passage tests with material from mosquito larvae and adults, ticks and lice, but, with a few inexplicable exceptions, these could be accounted for by the poor technique of inadequately trained assistants.

Although the virus is disseminated every year among domestic animals and irregularly among people, there was no outbreak of the disease in man in 1946.

A small outbreak had occurred in man and horses in 1947 in the areas from which the arthropods were collected. Circumstantial evidence that mosquitos are the vectors responsible for epidemics and epizootics, although not necessarily for the preservation of the virus from year to year, is very strong. The data here presented are not therefore thought to indicate that the mosquitos studied cannot be infected under natural conditions, but they do suggest that the infection rate is probably less than 1 in 100-1,000 during periods when small outbreaks are occurring among man and horses. Studies on the incidence of inapparent infection and the ecology of mosquitos in the affected regions suggest that *Culex tritaeniorhynchus* Giles and *Anopheles hyrcanus sinensis* Wied. are the most likely vectors. There are indications that the virus may be perpetuated in domestic mammals by a primary infection chain that does not depend on mosquitos. Investigations on ticks and lice should therefore be continued, although an arthropod vector may not be involved at all.

Reference is made in an appendix to a recent paper [*R.A.E.*, B **40** 162–163] containing reports of the finding of the virus in several lots of *C. tritaeniorhynchus* collected in Okayama just before an outbreak in 1948, and of failures to find it in large numbers of mosquitos collected at other times. These observations lend further support to the inferences drawn from the author's findings. The very low infection rate among the mosquito vectors suggests how improbable it is that perpetuation of the virus from year to year could be achieved by the very small numbers of hibernating mosquitos.

Papers noticed by Title only.

Wirth (W. W.). **The Heleidae** [Ceratopogonids] **of California.**—*Univ. Calif. Publ. Ent.* **9** no. 2 pp. 95–266, 33 figs., 6 pp. refs. Berkeley, Cal., 1952.

Böhm (O.). **Über die Wirkung von p,p′-Dichlordiphenyltrichloraethan (DDT) auf Insekten unter besonderer Berücksichtigung der Abhängigkeit der Kontaktgiftwirkung vom Bau des Insektenintegumentes. Beitrag zur Kenntnis der Wirkungsweise eines modernen synthetischen Kontaktinsektizides.** [On the Effect of p,p′DDT on Insects with special Reference to the Dependence of its Effectiveness as a Contact Poison on the Structure of the Insect Integument. Contribution to the Knowledge of the Mode of Action of a modern synthetic Contact Insecticide.]—*Pflanzenschutzberichte* **7** pt. 3–4 pp. 33–73, 10 figs., many refs. Vienna, 1951. (With a Summary in English.) [See *R.A.E.*, A **40** 374.]

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A

B

C

D

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* For relation to disease, see under Dengue, Encephalitis, *Filaria* spp., Malaria, Mengo Encephalomyelitis, Myxomatosis, Yellow Fever.

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